KPK BOARD NOTES

BIOLOGY

10TH CLASS

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Unit 9

Chemical Equilibrium

Q. 1 Define a chemical reaction.

Ans. **Chemical reaction:**

A chemical reaction is a chemical change in which one or more than one substance is converted to one or more different substances. In a chemical reaction, we have two types of substances i.e. reactants and products.

Reactants:

Those substances, which combine to form new substances in a chemical reaction, are called reactants.

Products:

Those substances, which are formed as a result of chemical reaction of reactants, are called products.

Example:

When one mole of nitrogen gas (N_2) and 3 moles of hydrogen gas (H_2) are combined in a chemical reaction, they form two moles of ammonia (NH_3).

$$N_{2\,(g)} + 3H_{2\,(g)} \longrightarrow 2NH_{3\,(g)}$$

In the above reaction, Nitrogen and Hydrogen are the reactants and Ammonia is the product, formed as a result of chemical reaction between Nitrogen and Hydrogen.

Q.2 Differentiate between "Irreversible Reactions" and "Reversible Reactions."

Ans. **Irreversible Reactions**

Definition:

Irreversible reactions are those reactions in which the products do not recombine to form the reactants. OR

Those reactions, which cannot get easily reversed, are called irreversible reactions.

Characteristics of Irreversible Reaction

i. Irreversible reactions stop upon completion.
ii. They can proceed to completion.
iii. These reactions start from the side of reactants only.
iv. They proceed only in one direction.
v. Equilibrium cannot be established in these reactions.
vi. They are represented by putting a single arrow ($\longrightarrow$) in between the reactants and products.

Example:

The reaction of magnesium (Mg) with excess of hydrochloric acid (HCl) is an irreversible reaction because magnesium chloride and hydrogen gas formed as a result of their (Mg+HCl) reaction, do not react to form magnesium and hydrochloric acid again.

Chemical reaction:

$$Mg_{(s)} + 2HCl_{(l)} \longrightarrow MgCl_{2(l)} + H_{2(g)}$$

Other examples of irreversible reactions are burning of natural gas in the presence of oxygen and reaction of sodium chloride (NaCl) with silver nitrate ($AgNO_3$).

$$CH_{4(g)} + O_{2(g)} \longrightarrow CO_{2(g)} + H_2O_{(g)}$$

$$NaCl_{(aq)} + AgNO_{3(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$$

Representation:

Ir-Reversible reactions are represented by putting a single arrow ($\longrightarrow$) in between the reactants and products which means that the reactants once consumed cannot be easily reproduced i.e. the reaction only proceeds in forward direction.

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- کوئی بھی ممبر کسی بھی ممبر کو انباکس میں میسیج، مس کال، کال نہیں کرے گا۔ رپورٹ پر فوری ریموو کرکے کاروائی عمل میں لائے جائے گی۔
- ہمارے کسی بھی گروپ میں سیاسی و فرقہ واریت کی بحث کی قطعاً کوئی گنجائش نہیں ہے۔
- اگر کسی کو بھی گروپ کے متعلق کسی قسم کی شکایت یا تجویز کی صورت میں ایڈمن سے رابطہ کیجئے۔
- سب سے اہم بات:

گروپ میں کسی بھی قادیانی، مرزائی، احمدی، گستاخِ رسول، گستاخِ امہات المؤمنین، گستاخِ صحابہ و خلفائے راشدین حضرت ابو بکر صدیق، حضرت عمر فاروق، حضرت عثمان غنی، حضرت علی المرتضیٰ، حضرت حسنین کریمین رضوان اللہ تعالیٰ اجمعین، گستاخ اہلبیت یا ایسے غیر مسلم جو اسلام اور پاکستان کے خلاف پراپیگنڈا میں مصروف ہیں یا ان کے روحانی وذہنی سپورٹرز کے لئے کوئی گنجائش نہیں ہے لہذا ایسے اشخاص بالکل بھی گروپ جوائن کرنے کی زحمت نہ کریں۔ معلوم ہونے پر فوراً ریموو کر دیا جائے گا۔

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اللہ تبارک تعالیٰ ہم سب کا حامی وناصر ہو

Unit - 9 Chemical Equilibrium

Reversible reactions

Definition:

Those reactions in which the products can react to form the reactants again are called reversible reactions.

OR

Those reactions which can be reversed easily are called reversible reactions.

Characteristics of Reversible Reaction

i. Reversible reactions never stop.
ii. These reactions never go to completion
iii. Reversible reactions can be started from either sides.
iv. These reactions proceed in both directions.
v. Equilibrium is established in these reactions.
vi. They are represented by putting a double half headed arrow ($\rightleftharpoons$) in between the reactants and products.

Example

Mercuric oxide (HgO) when heated in a closed test tube decomposes to mercury (Hg) and oxygen (O_2), but at the same time, mercury and oxygen recombine to form HgO again. Therefore, we can say that this reaction is a reversible reaction.

$$2HgO_{(s)} \rightleftharpoons 2Hg_{(l)} + O_{2(g)}$$

Besides this, the reaction of sulphur dioxide with oxygen and hydrogen with iodine are also examples of reversible reactions.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

Representation

In a reversible reaction the reactants and products are separated by double half-headed arrow ($\rightleftharpoons$) which shows that the reaction can proceed in both directions.

Q.3(a) What is a chemical equilibrium?

Ans. **Chemical equilibrium**

A reversible reaction is said to be in a state of chemical equilibrium if the rate of forward reaction is equal to the rate of backward reaction and the concentration of products and reactants remain constant.

Explanation:

In a reversible reaction, two types of reactions occur simultaneously i.e. forward reaction and reverse reaction. Forward reaction is the conversion of reactants into products and reverse reaction is the conversion of products back into reactants.

It can be easily understand by considering a general chemical reaction in which two reactants A and B react to form C and D.

$$A + B \rightleftharpoons C + D$$

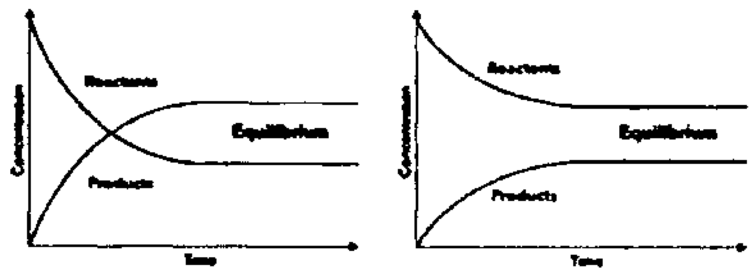
Initially, when no reaction has taken place, concentrations of A and B is maximum, and concentration of C and D is zero, but as the forward reaction proceeds the formation of C and D takes place which results in decrease of concentrations of A and B.

With the passage of time, the reaction also starts in reverse direction i.e. C and D are converted back into A and B. After some time, the rate of forward reaction becomes equal to the rate of reverse reaction. Now at this point, the concentration of both the reactants and products attain a constant value and there is no net change in the

concentration of reactants and products. The reaction seems to be stop because no more products are formed.

In fact, a reversible reaction does not stop and never goes to completion rather both the forward and reverse reactions occur simultaneously, at the same rate. Consequently, no change could be observed in the concentrations of products and reactants. Such equilibrium in a reversible reaction is called dynamic equilibrium.

Graphical representation of chemical equilibrium:



Rate of forward reaction:

Change in concentration of reactants per unit time is called rate of forward reaction.

Rate of reverse reaction:

Change in concentration of products per unit time is called rate of reverse reaction.

Mathematically,

$$\text{Rate} = \frac{\Delta(x)}{\Delta t}$$

Where $\Delta(x)$ = change in concentrati‸n of product orreactant.

Examples of chemical equilibrium:

Oxidation of Sulfur dioxide to sulfur trioxide is an

example of chemical equilibrium.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

Reaction of hydrogen and iodine to form hydrogen iodide is also an example of chemical equilibrium

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

These two reactions never go to completion and in these reactions, the rate of forward reaction is equal to the rate of reverse reaction.

Point to remember:

The statement that "the rate of forward and reverse reaction will be equal" does not mean that the concentration of reactants and products at equilibrium will also be equal,

Rather for a given reaction at equilibrium, the concentrations of reactants and products may be different from one another but once equilibrium is achieved their concentrations would become constant i.e. no further change in either of the concentration would occur. They can have different values but constant values.

Q.3 (b) Write types of Chemical Equilibrium.

Ans. Types of Chemical Equilibrium

There are two types of chemical equilibrium i.e.

i. Homogeneous Equilibrium
ii. Heterogeneous equilibrium.

Homogeneous Equilibrium:

It is the type of equilibrium in which all the reactants and products are in the same phase. Phase means the physical state of reactants and products.

Example

The reaction of Nitrogen with Oxygen to form nitric

oxide is a good example of homogeneous equilibrium because in this reaction the reactants and products are in the same physical state i.e. Gaseous state.

Chemical Reaction

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$$

Heterogeneous Equilibrium:

It is the type of equilibrium in whichthe reactants and products are in different phases. Phase means the physical state of reactants and products.

Example

The thermal decomposition of Calcium Carbonate ($CaCO_3$) to Calcium oxide (CaO) and Carbon dioxide (CO_2) is a good example of heterogeneous equilibrium because in this reaction $CaCO_3$ and CaO are in solid state and CO_2 is in gaseous state.

Chemical Reaction

$$CaCO_{3(s)} \rightleftharpoons CO_{2(g)} + CaO_{(s)}$$

Q.4 State law of mass action.

Ans. Law of mass action:

In 1864, two Norwegian chemists, Cato Maximilian Guldberg and Peter Waage presented Law of Mass action. This law shows a relationship between the concentration of reactants and products at equilibrium in a chemical reaction.



Cato Maximilian Guldberg Peter Waage

Statement:

The rate or speed of a chemical reaction is directly proportional to the product of the molar concentrations (active masses) of the reacting substances.

Active mass:

The term active mass represents the concentration of reactants and products in mol/dm^3 or we can say that it is the concentration of only those molecules which are taking part in a chemical reaction therefore the term active mass is also known as reactive mass or chemical activity. Active mass of a substance is expressed in terms of square brackets [].

Explanation:

Let us consider a general reaction, in which A and B react to form C and D i.e.

$$A + B \rightleftharpoons C + D$$

The active masses of A, B, C and D can be represented by [A], [B], [C] and [D] respectively.

From law of mass action, we know that the rate of reaction is directly proportional to the product of the concentrations of reactants, therefore;

Rate of forward reaction $\propto$ [A][B]

$$R_f \propto [A][B]$$

$$R_f = K_f\,[A][B]$$

Where K_f represents the rate constant for forward reaction

Similarly,

Rate of reverse reaction $\propto$ [C][D]

$$R_r \propto [C][D]$$

$$R_r = K_r\,[C][D]$$

Where K_r represents the rate constant for reverse reaction

We know that at equilibrium the rate of forward reaction is equal to rate of reverse reaction, so we can write it mathematically as

$$R_f = Rr$$

$$K_f[A][B] = K_r [C][D]$$

Rearranging this equation, we get

$$\frac{K_f}{K_r} = \frac{[C][D]}{[A][B]}$$

As we know that,

$$\frac{\text{Constant}}{\text{Constant}} = \text{Constant}$$

$$\text{Therefore,} \frac{K_f}{K_r} = K_c$$

Where K_c is called the equilibrium constant and its unit is different for different reactions. K_c will have no unit if the molar concentration of reactants and products are the same.

Q.5 Define equilibrium constant, Also, derive the expression for it. Discuss its units.

Ans. Definition:

Equilibrium constant is the ratio of the product of the concentration of substances formed(products) to the product of the concentration of substances consumed (reactants).

Each concentration term is raised to a power that is equal to the co-efficient of that substance in a chemical equation.

Explanation:

Let us consider a general reaction in which "a" moles of A reacts with "b" moles of B to form "c" moles of C and "d" moles of D

$$aA + bB \rightleftharpoons cC + dD$$

According to law of mass action

Rate of forward reaction $\propto [A]^a [B]^b$

$R_f = K_f [A]^a [B]^b$

Similarly,

Rate of reverse reaction $\propto [C]^c [D]^d$

$R_r = K_r [C]^c [D]^d$

At equilibrium

$R_f = Rr$

$K_f [A]^a [B]^b = K_r [C]^c [D]^d$

Rearranging this equation, we get

$$\frac{K_f}{K_r} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

As $\frac{K_f}{K_r} = K_c$

Therefore, $K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$

Where K_c is the equilibrium constant and it gives several information about a reaction under consideration.

The equilibrium constant of a reaction is independent of pressure, concentration and catalyst and its value is constant for a particular reaction.

For example:

- Changing the concentrations of reactants or products

of a reversible reaction at equilibrium, may disturb the equilibrium for some time but the reaction will achieve its K_c value again.

- Similarly, introducing a catalyst to a reversible reaction would just speed up the reaction to reach the equilibrium sooner, but the value of K_c will not be changed, i.e. with or without the catalyst equilibrium constant value for a reversible reaction would remain unchanged.

Units of equilibrium constant:

The unit of K_c is not a fix value. It is different for different reactions. However, it is easy to find out the unit of K_c from a balanced chemical equation.

As we know that

$$K_c = \frac{\text{molar concentration of the products}}{\text{molar concentration of the reactants}}$$

Units of molar concentration =

moles per decimeter Cube (mol/dm^3)

OR moles per Liter (mol/L)

As there are different equilibrium constant expressions for different reactions, the K_c will be having more than one unit.

Consider the following three cases in which K_c has a specific unit for each case.

Case 1: If number of moles of products and reactants are equal

Consider the following example, in which the number of moles of products and reactants are equal.

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

1mol 1mol 2mol

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$K_c = \frac{[mol/dm^3]^2}{[mol/dm^3][mol/dm^3]} = \frac{[mol/dm^3]^2}{[mol/dm^3]^2} = \text{No unit}$$

As both the units cancel each other,therefore K_c will have no unit in this case.

Case 2: If number of moles of products are greater than the reactants

Consider the following example in which the number of moles of product is greater than that of reactants.

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$$

$$K_c = \frac{[NO_2]^2}{[N_2O_4]}$$

$$K_c = \frac{[mol/dm^3]^2}{[mol/dm^3]} = mol/dm^3$$

In this case, K_c is left with a unit of mol/dm^3.

Case 3: If number of moles of products are less than the reactants

It can be explained with the help of the following example.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_c = \frac{[mol/dm^3]^2}{[mol/dm^3]\ [mol/dm^3]^3} = \frac{1}{[mol/dm^3]^2}$$

$$K_c = [mol/dm^3]^{-2}$$

The above three cases showed that K_c hasdifferent units for different reactions.

Q.6 Write down the conditions necessary for equilibrium.

Ans. When a dynamic equilibrium is attained by a chemical reaction then the reaction will be in a state of dynamic equilibrium forever until and unless certain conditions disturb the equilibrium.

Following are the conditions that are necessary to sustain equilibrium.

i. Concentration of the reactants and products

ii. Temperature of the system

iii. Pressure of the system

iv. Volume of the system

v. Catalyst must be the same during the reaction

If we keep constant all the above-mentioned conditions, then the reaction will be at equilibrium forever.

Points to remember:

- Equilibrium cannot be established in an open container because in an open container, the gaseous reactants and products may escape to the atmosphere and as a result, the equilibrium will not be attained by the system.
- A catalyst only changes the rate of a chemical reaction and it does not change the value of the equilibrium constant. It helps in attaining the equilibrium in a short time.

Q.7 How can one recognize that a system is at equilibrium?

Ans. Two methods are commonly used for recognizing the

status of a reaction i.e.

- Physical methods
- Chemical Methods

Physical methods:

Physical methods include refractometery, polarimetery, spectrophotometery etc. In physical methods, different properties of light are used for measuring the concentration of both the products and reactants in a given solution.

Chemical Methods:

Chemical methods may be titration, calorimetery etc. In chemical methods, various formulas (equations) are used for determining the unknown concentration of a substance from the known concentration of another substance.

However, in both type of methods, the concentration of the products and reactants are checked after regularintervals of time and when the concentration of reactants and products attain a constant value, reaction is said to be in equilibrium.

Q.8 Write down the importance of equilibrium constant.
(OR)
What are the important applications of equilibrium constant? (OR)
How will you predict the Direction and extent of a chemical reaction?

Ans. The value of equilibrium constant helps in determining the following information regarding a chemical reaction.

1. Direction of reaction
2. Extent of a chemical reaction
3. Effect of the external conditions on the position of

equilibrium

1. **Direction of reaction:**

Every reaction has a specific K_c value which helps in determining the direction of reaction. If we know the value of K_c for a reaction, then the direction of reaction can be determined from equilibrium constant expression, i.e.

$$K_c = \frac{\text{molar concentration of the products}}{\text{molar concentration of the reactants}}$$

The equilibrium constant expression shows that K_c is directly proportional to the concentration of the products therefore

- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is less than the given value of K_c then the system is not at equilibrium and more products will be formed in order to attain the equilibrium so we can say that the reaction will move in forward direction for attaining equilibrium.

It is also clear from the equilibrium expression that K_c varies inversely to the concentration of the reactants so,

- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is greater than the given value of K_c then the system is not at equilibrium and more reactants will be formed in order to attain the equilibrium so we can say that the reaction will move in reverse direction for attaining equilibrium.
- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is equal to K_c, then the

reaction is at equilibrium.

2. **Extent of a chemical reaction:**

Extent of a chemical reaction is determined from the K_c expression. Consider a general reaction.

$$aA + bB \rightleftharpoons cC + dD$$

The K_c expression for this reaction can be written as

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b} = \frac{[products]}{[reactants]}$$

It is obvious from K_c expression that if,

- **K_c is very small:** then it shows that the reaction has not proceeded in forward direction considerably/significantly, i.e. very less of the products are formed (such reactions are not considered favorable).
- **K_c is very large:**a large value of K_c shows that the reaction hasproceeded in forward direction to a greater extent,i.e. almost all of the reactants get converted into products (such reactions are considered favorable)
- **K_c is neither very large nor very small:**It reflects that both the products and the reactants are present to an appreciable extent in the equilibrium mixture, i.e. let's say when around 30 to 40 percent (may be 25, 35, 45 percent etc.) of the reactants get converted into products (such reactions are considered moderate).

3. **Effect of external conditions on Position of equilibrium:**

Equilibrium constant helps in determining the effect of external condition on the position of equilibrium. If external conditions as if pressure, temperature and concentration are not kept constant then the position of equilibrium will be

altered, i.e. equilibrium will be re-established at another position.

EXAMPLES

Example 9.1

Write the forward and reverse reaction for the following reversible reaction.

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2\,(g)}$$

Solution:

Forward reaction

$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2\,(g)}$$

Reverse reaction

$$2NO_{2\,(g)} \longrightarrow 2NO_{(g)} + O_{2(g)}$$

Example 9.2

Write an equilibrium constant expression for the reaction of nitrogen and hydrogen to form ammonia at 150 to 200 atmospheric pressure and 450°C to 500°C and Iron as catalyst.

Solution:

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

Example 9.3

In equilibrium mixture, the concentration of hydrogen and iodine is 0.04 moles/dm^3 each, while that of hydrogen Iodide is 0.08 moles/dm^3. Find K_c for the following reaction.

Chemical Reaction

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

Given

$[H_2] = 0.04 \text{ mol/dm}^3$

$[I_2] = 0.04 \text{ mol/dm}_3$

$[HI] = 0.08 \text{ mol/dm}^3$

Required

$K_c = ?$

Solution:

As the reaction given in the question is already balance so no need to balance the chemical equation.

We know that

$$K_c = \frac{[\text{products}]}{[\text{reactants}]}$$

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

Putting values

$$K_c = \frac{[0.08]^2}{[0.04][0.04]} = \frac{0.08 \times 0.08}{0.04 \times 0.04} = \frac{2 \times 2}{1 \times 1}$$

$K_c = 4$

(As number of moles of products and reactants are equal, therefore K_c will be left with no unit)

Example 9.4

For the given reaction at certain high temperature, the concentrations in a particularequilibrium mixture are $CO_{(g)}$ is 0.0600 mol/dm^3, $H_2O_{(g)}$ is 0.120 mol/dm^3, $CO_{2(g)}$ is 0.150 mol/dm^3 and $H_{2(g)}$is 0.300 mol/dm^3.

Calculate the value of equilibrium constant at this temperature.

$$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$$

Given

$[CO] = 0.0600\ mol/dm^3$

$[H_2O] = 0.120\ mol/dm^3$

$[CO_2] = 0.150\ mol/dm^3$

$[H_2] = 0.300\ mol/dm^3$

Required:

$K_c = ?$

Solution:

The K_c can be calculated from the equilibrium constant expression i.e.

$$K_c = \frac{[products]}{[reactants]}$$

The K_c expression for this reaction can be written as

$$K_c = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

Putting values

$$K_c = \frac{(0.150 mol/dm^3)(0.300 mol/dm^3)}{(0.0600 mol/dm^3)(0.120 mol/dm^3)} = 6.25$$

$K_c = 6.25$

==========

PROBLEMS

Practice Problem 9.1

Write the forward and reverse reaction for the following reversible reaction.

i. $C + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$

ii. $4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)} + 2Cl_{2(g)}$

Solution:

i. Forward reaction

$$C + H_2O_{(g)} \longrightarrow CO_{(g)} + H_{2(g)}$$

Reverse reaction

$$CO_{(g)} + H_{2(g)} \longrightarrow C + H_2O_{(g)}$$

ii. Forward reaction

$$4HCl_{(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)} + 2Cl_{2(g)}$$

Reverse reaction

$$2H_2O_{(g)} + 2Cl_{2(g)} \longrightarrow 4HCl_{(g)} + O_{2(g)}$$

Practice Problem 9.3

Write an equilibrium constant expression for the following reversible reactions.

a. $N_{2(g)} + 2O_{2(g)} \rightleftharpoons 2NO_{2(g)}$

b. $2N_{2(g)} + O_{2(g)} \rightleftharpoons 2N_2O_{(g)}$

c. $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

d. $PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$

Ans.

a. $$K_c = \frac{[NO_2]^2}{[N_2][O_2]^2}$$

b. $$K_c = \frac{[N_2O]^2}{[N_2]^2[O_2]}$$

c. $$K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

d. $$K_c = \frac{[PCl_5]}{[PCl_3][Cl_2]}$$

Practice problem 9.4

An equilibrium mixtures of N_2, O_2 and NO gases at 1500K is determined to consist of 6.4×10^{-3}mol/dm^3 of N_2, 1.7×10^{-3}mol/dm^{3}and 1.1×10^{-5}mol/dm^{3}of NO. What is the equilibrium constant for the system at this temperature?

Given

$[N_2] = 6.4 \times 10^{-3}$mol/dm^3

$[O_2] = 1.7\times 10^{-3}$mol/dm^3

$[NO] = 1.1 \times 10^{-5}$mol/dm^3

Required

$K_c = ?$

Chemical reaction

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$$

Solution:

The equilibrium constant expression for this reaction can be written as:

$$K_c = \frac{[NO]^2}{[N_2][O_2]}$$

Putting values

$$K_c = \frac{[1.1\times10^{-5}]^2}{[6.4\times10^{-3}][1.7\times10^{-3}]} = \frac{1.21\times10^{-10}}{10.88\times10^{-6}}$$

$K_c = 0.111 \times 10^{-10} \times 10^{6}$

$K_c = 0.111 \times 10^{-4}$

$K_c = 1.11 \times 10^{-5}$ mole/dm^3

EXERCISE

A. Choose the correct option.

1. At dynamic equilibrium

 a. the reverse reaction stops

 b.the forward reaction stops

 c.both forward and reverse reaction stops

 d. both forward and reverse reaction continue at the same rate

2. A reversible reaction has the following characteristics except

 a. They proceed in both direction

 b. They never complete

 c. Products do not form reactants again

 d. They are represented by $\rightleftharpoons$

3. The equilibrium constant expression for the reaction is

 $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

 a. $\frac{[2N][2O]}{[2NO]}$

 b. $\frac{[N]^2[O]^2}{[2NO]}$

 c. $\frac{[N_2][O_2]}{[NO]^2}$

 d. $\frac{[NO]^2}{[N_2][O_2]}$

4. The equilibrium constant (K_c) is:
   a. The sum of the two reactants
   b. The difference of two rate constants
   c. The ratio of the two rate constants
   d. The product of the two rate constants
5. When value of K_c is very small it shows that:
   a. Reaction will go in the forward direction
   b. Reaction will go in the reverse direction
   c. Reaction is at equilibrium
   d. Equilibrium will never establish
6. For which reaction the K_c will have no units.
   a. $4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O$
   b. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
   c. $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$
   d. $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$
7. When the value of K_c is very large it shows that
   a. Reaction is at equilibrium
   b. Equilibrium will never be achieved
   c. Reaction will move in forward direction
   d. Reaction will move in the reverse direction
8. Active mass means
   a. The total mass of reactants
   b. The total mass of products
   c. The total mass of products and reactants
   d. Concentration of reactants and products in moles per dm^3 in a dilute solution

9. For a reversible reaction $K_c = \frac{[C]^4}{[A]^3[B]^2}$ the equation will be:

a. $4C_{(g)} \rightleftharpoons 3A_{(g)} + 2B_{(g)}$

b. $4C_{(g)} \rightleftharpoons A_{3(g)} + B_{2(g)}$

c. $A_{3(g)} + B_{2(g)} \rightleftharpoons C_{4(g)}$

d. $3A_{(g)} + 2B_{(g)} \rightleftharpoons 4C_{(g)}$

10. The reaction between PCl_3 and Cl_2 will produce $PCl_{5(g)}$.

$PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$

The units of K_c for this reaction are:

a. Mol/dm^3

b. 1/mol.dm^3

c. dm^3/mol (Note: Answer given in book is wrong)

d. mol.dm^3

ANSWERS:

1	d	2	c	3	d	4	c	5	a
6	c	7	d	8	d	9	d	10	c

B. Write short answers to the following questions.

1. Define chemical equilibrium state with two examples.

Ans. A reversible reaction is said to be in equilibrium state when the rate of forward reaction equals the rate of reverse reaction

Examples:

Oxidation of sulfur dioxide to sulfur trioxide is an example of chemical equilibrium.

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

Reaction of hydrogen and iodine to form hydrogen iodide is also an example of chemical equilibrium

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

These two reactions never go to completion and in these reactions, the rate of forward reaction is equal to the rate of reverse reaction.

2. How would you identify that dynamic equilibrium is established?

Ans. Two methods i.e. physical and chemical methods are used for identifying that either dynamic equilibrium is established or not. In both methods, the concentration of the products and reactants are checked after regular interval of time and when the concentration of reactants and products attain a constant value after several readings then the reaction is said to be in equilibrium.

3. Compare the different macroscopic characteristics of forward and reverse reaction?

Ans. Difference between forward and reverse reaction

Forward reaction	Reverse reaction
Inforward reactions reactants react to form products	Inreverse reaction products react to form reactants
The direction of forward reaction is from left to right	The direction of reverse reaction is from right to left
The rate of forward reaction is fast in the	The rate of reverse reaction is negligible in the

beginning of the reaction	beginning of the reaction
Forward reaction slows down gradually with the passage of time.	Reverse reaction speeds up gradually

4. What information is required to predict the direction of chemical reaction?

Ans. For predicting the direction of a chemical reaction we must know

- the K_c value of a reaction
- the molar concentration ratio of the products to reactants

If both the values are known the direction can be predicted as given:

- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is less than K_c then the reaction will move in forward direction for attaining equilibrium.
- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is greater than K_c then the reaction will move in reverse direction for attaining equilibrium.
- If the ratio of the molar concentration of the products to the reactants $\frac{[\text{products}]}{[\text{reactants}]}$ is equal to K_c then the reaction is at equilibrium.

5. Relate the active mass with rate of a chemical reaction.

Ans. For the representation of a relation between the rate of a chemical reaction and active masses consider the following general reaction in which "a" moles of A reacts with "b" moles of B to form "c" moles of C and "d" moles of D

$$aA + bB \rightleftharpoons cC + dD$$

According to law of mass action

Rate of forward reaction $\propto [A]^a[B]^b$

$R_f = K_f [A]^a[B]^b$ i

Similarly,

Rate of reverse reaction $\propto [C]^c[D]^d$

$R_r = K_r [C]^c[D]^d$ ii

Equation i and ii relates the rate of a chemical reaction to the active masses presents in a chemical reaction.

6. At equilibrium a mixture of N_2, H_2 and NH_3 gas at 500°c is determined to consist of 0.602 mol/dm³ of N_2, 0.420 mol/dm³ of H_2 and 0.113 mol/dm³ of NH_3. What is the equilibrium constant for the reaction at this temperature?

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

Given:

$[N_2] = 0.602\ mol/dm^3$

$[H_2] = 0.420\ mol/dm^3$

$[NH_3] = 0.113\ mol/dm^3$

Chemical Reaction:

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

Required:

Equilibrium constant i.e. $K_c = ?$

Solution:

The K_c can be calculated from the equilibrium constant expression i.e.

$$K_c = \frac{[\text{products}]}{[\text{reactants}]}$$

The K_c expression for this reaction can be written as

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

Putting values

$$K_c = \frac{[0.113\ \text{mol/dm}^3]^2}{[0.602\ \text{mol/dm}^3][0.420\ \text{mol/dm}^3]^3}$$

Splitting the equation into units and values

$$K_c = \frac{[0.113]^2}{[0.602][0.420]^3}\ \frac{[\text{mol/dm}^3]^2}{[\text{mol/dm}^3][\text{mol/dm}^3]^3}$$

$$K_c = \frac{0.113}{0.602 \times 0.074}\ \frac{[\text{mol/dm}^3]^2}{[\text{mol/dm}^3]^4}$$

$$K_c = \frac{0.113}{0.045} \times \frac{1}{[\text{mol/dm}^3]^2}$$

$K_c = 0.28\ (\text{dm}^3)^2/\text{mol}^2 \text{or} L^2/\text{mol}^2$ Ans

7. State conditions necessary for equilibrium

Ans. See Question No. 6

8. Write equilibrium constant expression for the following reactions.

a. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

b. $2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)}$

c. $4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$

Ans. The equilibrium constant expressions are given below.

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_c = \frac{[H_2O]^2}{[H_2]^2[O_2]}$$

$$K_c = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$$

9. A reaction between gaseous sulfur dioxide and oxygen gas to produce gaseous sulfur trioxide takes place at 600°C. At that temperature, the concentration of SO_2 is found to be 1.50 mol/dm³, the concentration of O_2 is 1.25 mol/dm³ and the concentration of SO_3 is 3.50 mol/dm³. Using the balanced chemical equation calculate the equilibrium constant for this system.

Given

$[SO_2] = 1.50\ mol/dm^3$

$[O_2] = 1.25\ mol/dm^3$

$[SO_3] = 3.50\ mol/dm^3$

Required: Equilibrium constant i.e. $K_c = ?$

Solution:

Chemical Reaction:

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

The K_c can be calculated from the equilibrium constant expression i.e.

$$K_c = \frac{[products]}{[reactants]}$$

The K_c expression for this reaction can be written as

$$K_c = \frac{[SO_3]^2}{[SO_2][O_2]^2}$$

Putting values

$$K_c = \frac{[3.50\ mol/dm^3]^2}{[1.50\ mol/dm^3]^2[1.25\ mol/dm^3]}$$

Splitting the equation into units and values

$$K_c = \frac{[3.50]^2}{[1.50]^2[1.25]} \times \frac{[mol/dm^3]^2}{[mol/dm^3]^2[mol/dm^3]}$$

$$K_c = \frac{12.25}{2.25 \times 1.25} \times \frac{[mol/dm^3]^2}{[mol/dm^3]^3}$$

$$K_c = \frac{12.25}{2.81} \times \frac{1}{[mol/dm^3]}$$

K_c =4.36dm^3/molorL/molAns.

10. Describe the effect of temperature on equilibrium constant.

Ans. The K_c value for a particular reaction is constant at constant temperature.A change in temperature will definitely results into the increase or decrease in the value of K_c depending upon the nature of reaction.

Generally, for an endothermic reaction an increase in temperature increases the value of K_c and vice versa.

For an exothermic reaction an increase in temperature decreases the value of K_c and viceversa.

C. Write detailed answers to the following questions.

1. $SO_{3(g)}$ decomposes to form $SO_{2(g)}$ and $O_{2(g)}$ for this reaction write

i. Chemical equation

ii. K_c expression

iii. Derive the unit of K_c for this reaction

Ans. i. Chemical Equation

$$2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$$

ii. K_c expression

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$

iii. Unit of K_c:

$$K_c = \frac{[mol/dm^3]^2[mol/dm^3]}{[mol/dm^3]^2}$$

$$K_c = \frac{[mol/dm^3]^3}{[mol/dm^3]^2} = mol/dm^3$$

2.a) Describe the equilibrium state with the help of a graph and an example.

Ans. See Question 3

b) Define Law of mass action.

Ans. See Question 4

3. Derive an expression for equilibrium constant and explain its units.

Ans. See Question 5

4.a) K_c has different units in different reactions. Prove it with suitable examples.

Ans. See Question 5 Topic: Units of equilibrium constant.

b) How can you predict the extent of reaction from K_c value.

Ans. See Question 8 Topic: Extent of a chemical reaction.

5.a) K_c expression for a reaction is given below

$$K_c = \frac{[Cl_2]^2[H_2O]^2}{[HCl]^4[O_2]}$$

For this reaction write

i. Reactants and products

ii. Derive the units of K_c

Ans. The chemical reaction for the given K_c expression will be

$$4HCl_{(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)} + Cl_{2(g)}$$

i. **Reactants:** HCl and O_2

Products: H_2O and Cl_2

ii. **Unit of K_c:**

$$\text{Unit of } K_c = \frac{[mol/dm^3]^2[mol/dm^3]}{[mol/dm^3]^4[mol/dm^3]}$$

$$= \frac{[mol/dm^3]^3}{[mol/dm^3]^5}$$

$$\text{Unit of } K_c = \frac{1}{[mol/dm^3]^2} = \left[\frac{dm^3}{mol}\right]^2$$

OR $K_c = (L/mol)^2 L^2/mol^2$ As $1dm^3 = 1$ liter

b) Explain the importance of equilibrium constant support your answer with examples.

Ans. See Question 8

Homeostasis

UNIT-11

Q-1: Define Homeostasis, why it is necessary for living organism?

Answer: Homeostasis.

Meaning:- Greek word: "Homeo"— same, "stasis"—standing.

Definition:- The ability of an organism to maintain its internal environment constant or nearly constant is known as homeostasis.

Importance of Homeostasis:- Homeostasis is necessary for living organism because—

1- Homeostasis is necessary for normal body functions.

2- It enables an organism to get rid of waste products.

3- It maintains a constant level of salt, water and temperature.

4- In homeostasis there is check and balance system which is necessary in the body.

5- Such controlling mechanism helps to prevent drastic changes within the body of organism.

Q-2: Write the different aspects of Homeostasis.

Answer: Aspects of Homeostasis:- There are three aspects of homeostasis. They are—

①- Osmoregulation:- It is the regulation of water

and solutes between organisms and their environment.

②- Excretion :- The mechanism which eliminates or removes metabolic wastes especially nitrogenous wastes is called excretion.

③- Thermoregulation :- The maintaince of internal temperature within a range that allows the cells to function efficiently is called thermoregulation.

(Q-3:) Explain Osmoregulation in plants.

Answer: Osmoregulation in plants :- Osmoregulation has enabled the plants to be distributed in wide range of habitat. on the basis of water availability, plants are divided into the following 3- types.

①- Mesophytes:

Meaning :- "Meso"— moist/medium, "phyton"— plant

Definition :- Those plants which grow in average condition of moisture is known as mesophytes.

Adaptation to conserve water (for Osmoregulation)

1- In these plants root hairs are well developed.

2- They have normal stomata which control water because mesophyte grow in moderate water supply condition.

3- Their body is covered by a layer known as cuticle which prevents transpiration.

4- In sufficient supple of water stomata are kept open to promote loss of excess water.

5- when the water supply decreases, the stomata are gradually closed to prevent the water loss.

Examples :- citrus , brassica , pea , rose , peach, maize

②- Hydrophytes:

Meaning :- "Hydro" — water , "phyton" — plant

Definition :- Those plants which grow in or near water is known as hydrophytes.

Adaptation to remove extra water ⟨for osmoregulation⟩

1- Roots are reduced and without root hairs.

2- In most plants the surface areas of leaves is very large and thus transpire water excessively.

3- They have large number of stomata on the upper surface which help in excessive transpiration.

4- Their body is without cuticle, result more water is lost.

Examples: — Hydrilla , lily , vallisneria , etc.

③- Xerophytes:

Meaning :- "xero" — dry , "phyton" — plant.

Definition :- Those plants which grow in dry, hot and sandy places is known as xerophytes.

Adaptation to conserve water <for osmoregulation>

1- Roots are long and deep in order to reach low water table.

2- The leaves are reduced in size, and modified into spines to reduce transpiration.

3- The stem has water storage tissue to resist the dry condition.

4- Stem and Leaves are hairy to absorb moisture from atmosphere. → (Such stems/roots are soft and juicy called Succulent organs.)

5- Leaves have thick cuticle on epidermis.

6- Stomata are sunken and very few in number.

Examples:- cactus, opuntia, Acacia, Zizyphus.

(4)- Halophytes:

meaning:- Halo — salt, phyte — plant.

Definition:- Those plants which grow in soil with high salts concentration is known as Halophytes.

Adaptation / characteristics:-

1- Halophytes ar not salt lover but salt tolerant plant.

2- Halophytes possess xerophytic charactes i.e

→ leaves contain water storage tissues.

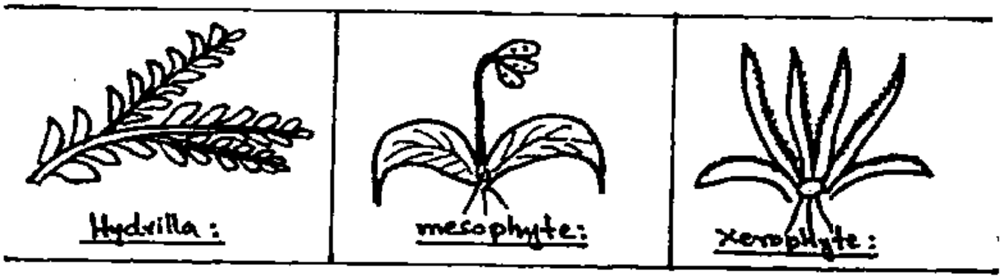
→ leaves are covered with thick cuticle.

3- Their bodies contain less salt than External Environment so water tries to move out from their bodies.

4- such plants absorb salts by active transport.

5- They store exess salt in cell or Excreted out from salt glands on leaves.

Example :- Salt wort, Rhizophora. etc.



(Q-4:) How Excretion occurs in plants.

Answer: Excretion in plants:

Introduction :- The removal of metabolic water from the body of an organism is called excretion. plant have no special organs for excretion because the metabolic wastes which they produce are used by plants for it own activities. But still they have many harmful or useless substances to be removed for the sak of Homeostasis.

Mechanism of Excretion :- plants do not possess any special organs for excretion. They get rid of different wast in different ways, such as—

①- Excretion of gases:

a)- Carbon dioxide (CO_2):- CO_2 is produced inside plant body during respiration and is used by plants again for the process of photosynthesis in day times. At night time no photosynthesis occurs so plant remove CO_2 to atmosphere through stomata.

b)- Oxygen:- During photosynthesis oxygen gas is produced. Some part of this oxygen is used by plants in the process of respiration. The remaining oxygen is removed from the plant body by stomata present in the leaves.

②- Excretion of water:

plants excrete the extra water by transpiration and.....
...guttation.i.e-

a)- Transpiration:- In this way extra water of a plant is excreted in the form of vapours through stomata, cuticle and lenticles. It occurs
-during day time.

b)- Guttation:- In this method extra water in the form of droplets oozes out through special cells called "Hydrathods" found on the margins of certains leaves. e.g- strawberry, etc.
-It occurs during night time in grasses leafs.



③- Shedding of Leaves:

It is another method by which plants remove their wastes. In autumn season certain poisonous materials

start to accumulate in Leaves, these are removed with the falling of leaves, when the Leaf become yellow and dry.

4- Excretion of secretory products:

certain plants have glandular cells which secrete different chemicals like— gums, resins, alkaloids and Latex, which are present in special ducts or canals. when the plants are injured these secretion ooze out from the damage part. It is also called plant bleeding.

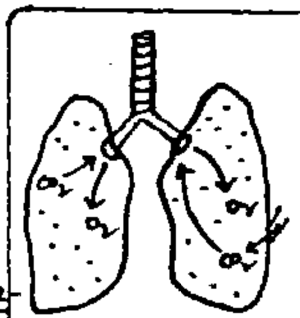
Q-5: How lungs act as homeostatic organs.

Answer: Lungs as homeostatic organs:

Introduction:- In respiration CO_2 and water vapours are produced. CO_2 and water require to be eliminated from the body because CO_2 is an acidic gas can change the pH of the blood, making it more acidic. This may cause the disturbance of the chemical reaction in the body. so can disturb the homeostasis.

Explanation:

lungs perform a major role in the excretion of CO_2 and thus maintain the homeostatic balance of the body. i.e



Human Lungs:

→ CO_2 diffuse from tissue into blood and gets dissolved in the plasma of the blood and reaches the Lungs. In lungs the CO_2 is release

due to less concentration of CO_2 in lungs. from lungs CO_2 is removed to atmosphere during exhalation

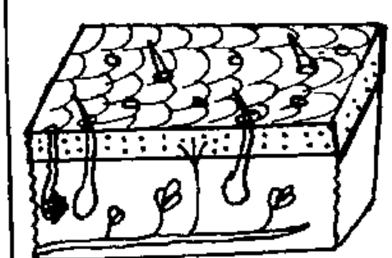
Dogs do not have pores in their skin, hence they keep their tongue hanging outside their mouth to increase evaporation of water which in response produce a cooling effect.

(Q-6:) How skin helps in homeostasis ⟨Thermoregulation⟩

Answer: Skin as homeostatic organ:- Skin in human beings and other mammals acts as thermoregulatory organ. The normal temperature of our body is 37°C or 98.6°F. Variation in temperature can cause disturbance in various functions and metabolic reactions of our body. Skin keeps it in normal range by many ways. i.e —

①-Thermoregulation when cool:- To prevent over cooling our skin perform the following functions—

a)- Vasoconstriction:- during cold season the diameter of some arteries which supples blood to skin, become reduced, resulting in less blood transport to skin and loss of heat is reduced.



Human skin:

b)- No sweating:- sweat is not produced during over cooling. it also decrease the rate of heat loss.

c)- Insulator layer:- A fatty layer in the hypodermis of

skin provides insulation and is very significant to conserve heat.

d)- Skin hair:- The hairs of human skin act insulating organs and Reduce the heat loss.

②. Thermoregulation when warm:

If the body gains or produces heat faster than it is losing, the following processes occur.

a)- Vasodilation:- During hot season certain blood vessels become dilated, as a result more blood flows toward skin to release more heat.

b)- Sweating:- Due to sweating partial control of heat loss is possible. It also remove extra water, salts, waste from the body.

c)- Radiation:- about 50% of the total heat is lost due to radiation in human body.

(Q-7:) How kidneys act as a homeostatic organ. -OR- Briefly describe how kidneys control the composition of blood.

Answer: Kidney as homeostatic organ:- Kidney is an excretory as well as osmoregulatory organs. The concentration of body fluid is kept narrow limited by the kidneys.

1- Kidney as a Excretory organ :- Kidney filter out Nitrogenous wastes such as-Urea, Uric-acid, NH_3, from the blood and excrete them from the body in the form of Urine. They also expel drugs, used Hormones and excess of salts.

2- Kidney as a Osmoreglutory organ :- Kidney is the most important Osmoreglutory organ. It Keep the concentration of our body fluids i.e- blood and plasma in normal range. i.e-

i)- If the blood contains more water, then less water will be reabsorbed from glomerulus filtrate and more Urine will be formed.

ii)- If the body is dificient of water then more water will be reabsorbed from the glomerulus filtrate and less urine will be excreted.

Note: Liver also plays role in Homeostasis. It breaks the Haemoglobin of dead RBCs. The products of Haemoglobin breakdown are sent to kidneys for removal. Liver changes the ammonia to urea. Urea is then removed from the body by Kidneys.

Q-8) What is urinary system of Human? Write its Components.

Answer :- Urinary System of Human :

Definition :- "The organs which form, store and remove urine from the body, make a system called urinary system"

Components :- Urinary system consists of-

①- A pair of Kidneys :

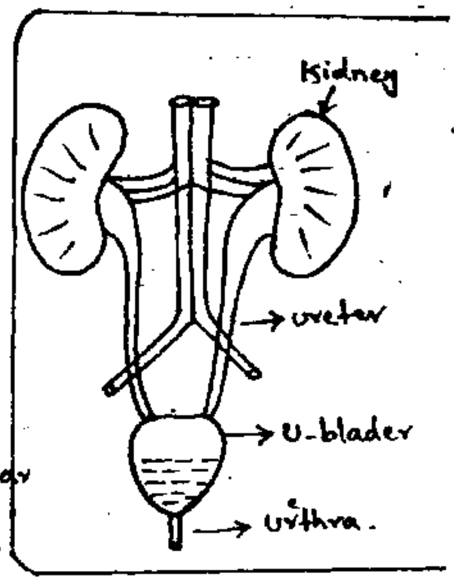
Kidney is a part of urinary system. It contributes to Hoemostasis by forming urine and remove from the body. thus maintain the balance of salts and water in the blood.

②- A pair of ureters :

A pair of narrow, muscular, tubular structure called ureters, which arise from the hilus of the kidney and open on the dorsal wall of the urinary bladder. They pass urine from the kidneys to the urinary bladder.

③- Urinary bladder :- It is a thick muscular pear shaped sac present in the pelvic region of the abdominal cavity. It temporarily stores urine.

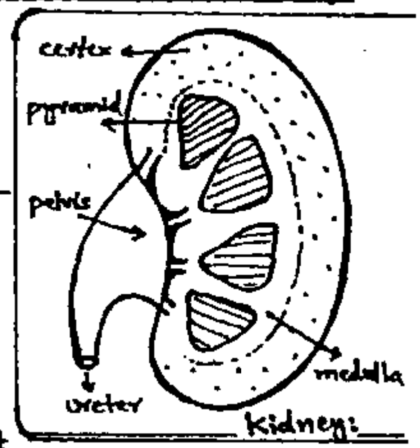
④- Urethra :- A narrow muscular tube arises from urinary bladder



called urethra, that carries urine from the urinary bladder to the outside.

Q.9: Describe the structure of human Kidney.

Answer: Human Kidney:



Kidney is a part of urinary system. It contributes to homeo-stasis by forming urine and remove from the body. Kidneys are placed against the back wall of the abdominal cavity just below the diaphragm. The right kidney is a little lower than the left one because of a liver lobe above it.

1- External structure:

Protection:- Both the kidneys are protected by a very thin membrane called peritoneum, or by some fats.

Colour:- Kidneys are darked or reddish brown in colour.

Shape:- Kidneys are bean shaped. The outer surface is convex and the inner surface is concave.

Size:- Kidneys are about 10-cm long, 5-cm wide and 4-cm thick.

Hillus:- It is a depression or invegination at the concave side of kidney through which blood vessels and ureter enter the kidney.

(2)- Internal structure:- In the Internal transvere section there are two general regions. i.e—

i). Cortex :- It is the outer darker region of Kidney.

ii)- Medulla :- It is the inner thicker and lighter region of kidney.

Pyramids :- The medulla Contains 10—15 conical structure called pyramids.

Nephron :- A Kidney consists of millions of functional units called as nephron, each nephron is Surrounded by blood capillaries network.

pelvis :- It is central cavity of the Kidney which collects urine from collecting tubules and then open to ureter. Ureter then open into urinary bladder which emptied through urethra.

(Q-10:) what is nephron, write its structure and function.

Answer: Nephron :

Introduction :- Nephrons are the structural and function--al units in human Kidneys. Each human Kidney contains about one-million nephrons.

Structure of Nephron :- Each nephron has following parts-

(1)- Renal Corpusle :-

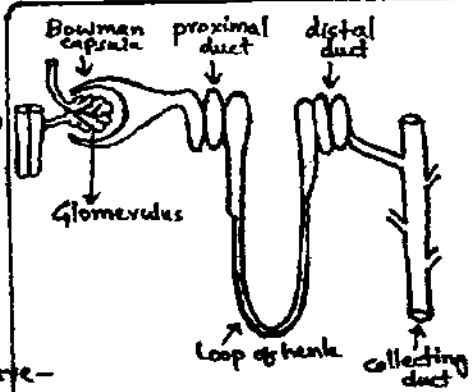
It is the initial filtering component of the nephron. it is Composed of two components. i.e—

(a)- Bowman's capsule :- one end of nephron is expanded forming a cup-shaped structure called bowman's capsule.

(b)-Glomerulus :- Bowman's capsule contains a group of blood capillaries called glomerulus.

(2)- Renal tubule :

The tubular portion of nephron refines the glomerulus filtrate by reabsorbs the important substances from urine. The components of the renal tubules are-



Nephron:

(a)-proximal convoluted tubules:

It is the first portion of the duct system of the nephron which leads from bowman's capsule to the loop of henle.

(b)- Loop of henle :- It is the narrow part of nephron which desends down into the renal medulla.

(c)-distal Convoluted tubule :- It is Last portion of duct system of nephron.

Collecting duct :- Each distal convoluted tubule Leads to collecting ducts. Finally, collecting duct delivers urine into renal pelvis.

(Q-11 :) Discuss the process of urine formation. -OR- Write the function of Nephron.

Answer: **Process of urine formation:-** Nephron is functional unit of the kidney, which filters the blood, remove wastes in the form of urine. formation of urine involves three processes. i.e—

①- pressure filtration:

Filtration pressure:- Due to less diameter the capillaries or glomerulus offer resistance for the flow of blood. This resistance causes high blood pressure in glomerulus called filtration pressure.

porous wall:- The glomerulus walls are porous and the fraction of the blood pressure reaching here provides the filtration pressure. Therefore the blood passing through the glomerulus is filtered (about 20%) into Bowman's capsule.

Glomerular filtrate:- The filtrate which is formed in the glomerulus is called as glomerular filtrate or pressure filtrate. glomerular filtrate contains — water, glucose, salts, drugs, Hormones, vitamines, Urea, Uric-acid and other nitrogenous wastes.

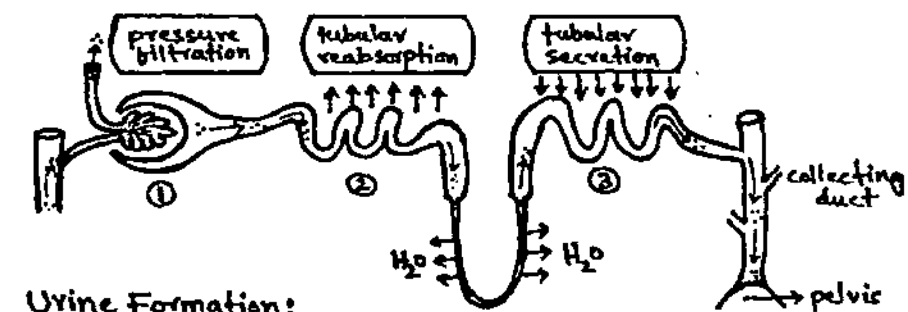
②- Reabsorption:- only the useful substance for the body are reabsorbed because the reabsorption is very selective process. i.e-

1- In proximal portion of nephron all of the—glucose, amino-acids, vitamins, hormones and about 80%

of the sodium-chlorid (Nacl) and water, are reabsorbed.

2- Solute (e.g- Na^+) are reabsorbed from loop of Henle.

3- most of the water is reab orbed from the distal convoluted tubule and collecting duct.



Urine Formation:

③- Tubular secretion :- It is a active transport in which material transfer from capillaries to renal tubular lumen. In tubular secretion process only a few substance are secreted because these substances are present in great great excess, or are natural poisons.

For example :- most important substances secreted by tubular secretion are— Hydrogens (H^+), potassium (K^+), organic ions and many drugs. Now the filtrate is changed into urine.

Excretion of urine :- The final product or urine now passes out of the nephron into the pelvis, from where it passes to the outside through ureter, urinary bladder and urethra. The urethra opens through the penis in males

or near the vagina in females.

Control of urination:- A ring of sphincter muscles is found in the bladder which controls the urination when about 300 to 400 mL urine is collected in the bladder, we need to discharge it. This sphincter is not properly developed in babies and therefore, they are not able to control their urination.

Q-12: Describe the role of Kidney as osmoregulatory organ.

Answer:- Osmoregulation and Kidneys:

Kidneys are not only the excretory organs but they also act as osmoregulatory organs. The concentration of body fluid is kept within narrow limits by the Kidneys.

Control of water level:

1- If the blood contains more water, then less water will be reabsorbed from glomerulus filtrate and more urine will be formed.

2- If the body is dificient of water then more water will be reabsorbed from glomerulus filtrate and less urine will be formed.

Role of ADH in control of water level:

ADH is secreted by the posterior lobe of pituitary gland. ADH stimulates the reabsorption of water in the distal portion of nephron. i.e-

1)- Dehydration of body (less water in body), stimulates

the secretion of ADH which then increases the reabsorption of water.

2)- If the blood is more dilute (more water in body), the secretion of ADH is inhibited. The distal part of nephron then fails to reabsorb water and more water is excreted in urine.

→ Kidneys also regulate the solute level such as- Na^+ ions.

> Kidney is adopted to conserve water by over 99.5% reabsorption of glomerular filterate.

(Q-13:) write a note on Kidney disorders.

Answer: Disorders of Kidneys:

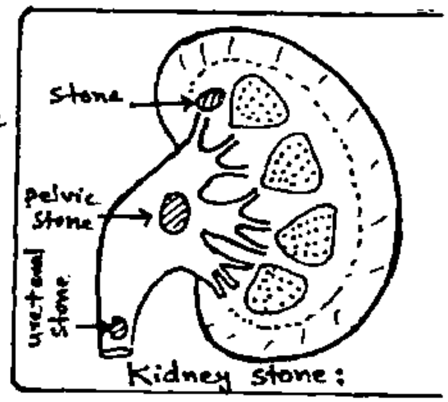
Definition:- Any abnormality that occur in kidney is called disorder of kidney.

Explanation:- Any abnormality that affects the normal function of kidney is called kidney disorder. Human kidneys start functioning during fatal life after four months of gestation and keep working throughout the life. But sometimes due to internal or external factors the normal working of kidney might be disturbed. These situations are called disorders of the kidney.

Example:- Kidney stones, Renal failure, etc.

Q-14) What are kidney stones and how they are formed. Suggest through which these stones are removed from body.

Answer: Kidney stones:



Definition :- Kidney stones are small, hard deposits of different salts or substances inside the kidneys.

Formation of kidney stone:

Calcium oxalate, calicum phosphate and uric-acid are precipitated out during urine formation and accumulate later to form stone. They cause obstruction in the urinary tract. Generally they cause severe pain when they enter the pelvis or ureter, stopping the release of urine from the kidney.

Causes of kidney stone:

1- presence of more calcium-oxalate, calcium and ammonium-phosphates in diet (green vegetables, tomatoes, fats, dairy products) is the major cause of kidney stones.

2- Extra amounts of vitamins-C and D in diet may also cause kidney stones.

3- The other causes of kidney stones are - reduced water

intake, Excess uric-acid in the blood, urinary tract infections, and Alcohol consumption.

Symptoms of Kidney Stones:

1- patients of Kidney stones feel sever pain in Kidney or lower abdomen.

2- other symptoms of Kidney Stones include — Nausa, Vomiting, burning in urethra, frequent urination, foul-smelling urine, blood and pus in the urine and bloating.

Types: (chemical nature of stones)

Kidney stones may be of the following types —

①- **Calcium oxalate** :- about 70% of all the kidney stones are calcium oxalate. calcium is found in fruits, green vegetables, milk, eggs, and almonds. while oxalates are present in tomato and green vegetables.

②- **calcium phosphate** :- The incidence of calcium-phosphate type of stones is 15%.

③- **Uric-acid stones** :- The incidence of uric-acid Stones is 5—10%.

Treatment of Kidney Stones:-

(1)- Drink of water :- If kidney stones are small in size, the patient is advised to drink plenty of water (at least eight glasses in a day).

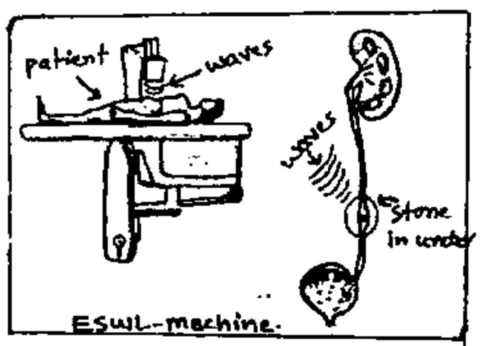
(2)-Lithotripsy :-

The technique of non-sugrical removal of kidney stone is called lithotripsy. This technique is used to break up stones present in the kidney, ureter or gall bladder. There are several ways to break these stones. The most common method is — "Extracorporeal Shock Wave Lithotripsy (ESWL)

i.e—

ESWL procedure :

1- The stone (4mm–2cm) inside kidney is bombarded with highly concentrated X-rays or ultrasound waves generated by a machine called lithotriptor.



2- The shock waves break the stone into tiny pieces or into sand. These tiny pieces or sand are then passed out of the body in urine.

(3)- Surgry :-

If stones are large and cannot pass easily, the patient has to undergo sugery. patient's kidney, ureter, or urinary bladder is opened and stones are removed.

Q-15: what is Renal failure, write its various causes. and symptoms.

Answer: Renal failure : (Kidney failure)

Definition :- Renal failure is a medical condition in which the normal functions of Kidneys is gradually descreased.

Explanation: Sometime the working of Kidney or nephron is badly damaged due to certain reason or infection. They are not able to filter the harmful nitrogenous substances, it is called Kidney failure. In such conditions the harmful substances remain in blood, the amount of urea and dangerous substances is increased in blood which causes high blood pressure and anemia diseases. It also cause death of a patient.

Causes :- infection, Heart diseases, blood pressure — medications or other drugs, Diabetes, An inflammation of the Kidneys filtering units, prolonged obstruction of the urinary tract, high blood pressure, etc.

Symptoms :-

1- In renal failure, nephrons are not able to filter the blood properly, level of urea and other nitrogenous waste in blood increases.

2- other symptoms include — weight loss, Vomiting, nausa

and blood in the urine.

3- Due to Exess fluid in body, there is swelling in the legs feet and face.

Treatment :- Renal failure can be treated through dialysis or Kidney-transplant.

Q-16 : what is dialysis, write its types.

Answer : Dialysis :

Meaning :- Dialysis is a Greek word which means-"Separation"

Definition :- It is a technique which is used to remove harmful waste products and excess amount of water from the blood.

→ It is an artificial method of blood filtration and purification.

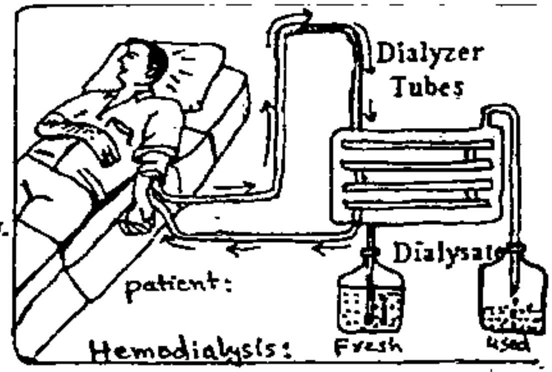
Types of dialysis :

①- Hemodialysis :

Introduction :- Hemodialysis means — "Cleaning the blood."
In hemodialysis, a machine filters wastes, salts and fluid from blood, are used when Kidneys are no longer healthly enough to do this work normaly.

↓
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Procedure :



1- A filter that acts as an artificial Kidney to clean blood is called dialyzer.

2- Dialyzer contains a artificial semi-permeable-membrane which allow selected material to pass through it from blood of patient.

3- During hemodialysis two needles are inserted into arm through the access.

4- Each needle is attached to a flexible plastic tube that connects to a dialyzer.

5- Through one tube blood from an blood vessel in the arm of the patient is pumped slowly into the dialyzer.

6- Urea and other waste materials diffuse from the blood into the dialysate fluid.

7- The filtered blood returns to body arm through the second tube.

Required :- The patient uses Kidney machine or dialyzer two or three times a week. It takes about 4 or 5-hours.

(2)- peritoneal dialysis:

Introduction :- peritoneal dialysis is a way to remove waste products from blood when Kidneys can no longer do the job normaly. peritoneal dialysis makes use of a natural-

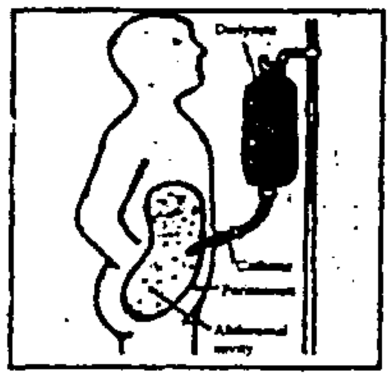
membrane in the body.

Procedure :- 1. In this process two catheters are surgically inserted into the abdominal cavity, through which dialysate (dialysis fluid) enters and Leaves the cavity.

2- The solution stays in abdomen for a prescribed peroid of time, Known as dwell time.

3- During this dwell time, waste, chemicals and extra-fluid in the blood pass from tiny blood vessels (capillaries) in the Lining of abdominal cavity (peritoneum) into the dialysis solution.

4- when the dwell time is over, the solution, along with waste products is drawn from blood and any excess fluid, drains into a steril collection bag.



Required :- This process requires about one hour and it is repeated the next day.

(Q-17) What is Kidney Transportation.

Answer:- Kidney transplantation:

Definition :- The implantation of Kidney from a donor person to a person whose Kidney have no longer function properly through surgery is called Kidney Transplantation.

Explanation :- The surgeon make an incision in body of vecipient and then place the donated Kidney in its correct place. The ureter of the new Kidney is now connected to bladder.

Donor-Recipient match :- In all cases, the donor's Kidney is matched with the patients (recipient) immune System, otherwise the donated Kidney will be rejected by recipient body (immune system).

(Q-18:) what are the Contributions of muslim Scientists in the treatment of Kidney's problems.

Answer :- **contribution of muslim scientists:**

Introduction :- Various muslim scientists contributed to the studies of Kidneys of various times, Among them, the following are well known.

(1) — Abdul-Qasim :- Abdul-Qasim was born in 936-A.D. in zahra near cordova. He was know in the West as Abulcasis.

Contributions :-

1- He was the most famous surgeons of the muslim era.

2- His best work was his famous medical Encyclopedias

called Al-Tasrif. it is composed of 30- volumes.

3- He has described various aspects of surgical treatment including-removal of stone from the bladder dissection of animals and surgery of throat, ear and eye.

②- Al-Farabi :

Introduction:- The great Turkish philosopher and Scientist Abu Nasr Al-Farabi, Known as Alpharabus. He was born in 872.

Contributions :-

1- He wrote many books.

2- He provided a lot of inflammation about Kidney diseases, including stones in urinary bladder.

③ — Al-Razi :

Introduction :- His full name is Abu Baker Muhammad Ibn Zakariya. Al-Razi was born in Ray (persia) in

Contributions:

1- He was a well Known muslim, Scholar and philosopher.

2- He worked on causes of Kidney and bladder stones.

3- He also introduced different techniques to remove stones.

4- His famous book is- "Ketab dar padid Amadaneh sangrizeh (persian)." The book of formation of small small stones in the Kidney and bladder which got high fame all over the world.

Exercise

(Q-A:) Encircle the best suitable answer.

1- organisms have the ability to change and modify their internal conditions according to the environment through

(a)- Osmoregulation (b)- Excretion (c) Thermoregulation (d) All

2- All of the following are the adaptation of xerophytes except

(a)- thick cuticle (b)- large No of stomata

(c) Sunken stomata (d)- Deep root system.

3 The loss of water from the plants in the form of small droplets is

(a)- Stomatal transpiration (b)- cuticular transpiration

(c)- lenticular transpiration (d)- Guttation.

4- From Nephron, wastes enter into the-

(a)- Ureter (b)-collecting duct (c) convoluted tubules (d) medulla

5- The tube between kidney and urinary bladder is the-

(a)- ureter (b)- urethra (c)-Renal tube (d) Nephron.

6- waste products excreted by kidneys are.

(a)- urea, water, salts (b)-salts, water, CO_2.

(c)- urea, and water (d)- urea and salts.

7- Secretion of urea in sweat makes skin a —

(a)- Respiratory organ (b)- Breathing organ

✓(c)- Excretary organ (d)- Digestive organ.

(8)- The two main functions of sweat are to-

(a)- Keep the body coal and to remove excess proteins.

(b)- Keep the body warm and to filter the blood.

(c)- Filter the blood and to remove waste products.

✓(d)- Remove waste products and to cool the body.

(9)- which is NOT present in the filt rate entering the Browman's capsule of nephron?

(a)- water (b)- calcium ions ✓(c)- Blood cells (d)- Urea.

(10)- liver also plays role in excretion. It make urea from-

(a)- Uric-acid ✓(b)- Ammonia (c)- CO_2 (d)- Amino-acids.

(Q-B:) Write short answers to the following question.

(1)- Define Homeostasis and osmoregulation.

Answer:

Homeostasis:- The ability of an organism to maintain its internal enivronment cons nt or nearly constant is known as Homeostrsis.

Osmoregulation:- It is the regulation of water and

Solutes between organisms and their environement.

② - Differentiate b/w the adaptation of hydrophytes and xerophytes for osmoregulation.

Answer :- See Q-No-3, only part-2 and part-3. (p-29)

③ - Briefly describe how Kidneys control the composition of blood.

Answer :- See question No-7, at page No-35

④ - Enlist materials in our diet which are more likely to cause kidney stones?

Answer :- See only causes of kidney stones from question No-14, at page No-45

⑤ - Define lithotripsy?

Answer :- See part-2 of question No-14, at page-47

⑥ - what is the role of Skin in thermoregulation.

Answer :- See question No-6, at page No-34

⑦ - which term is used for the disease when one or both kidneys does not perform its functions.

Answer :-

Term Renal failure used for the disease when one or both Kidney does not perform its function.

Renal failure :- (Kidney failure).

Definition :- Renal failure is a medical condition in which the normal functions of kidneys is gradually descreased.

Explanation: Sometime the working of kidney or nephron is badly damaged due to certain reason or infection. They are not able to filter the harmful nitrogenous substances, it is called kidney failure. In such conditions the harmful substances remain in blood, the amount of urea and dangerous substances is increased in blood which causes high blood pressure and anemia diseases. It also cause death of a patient.

(Q-C:) write detailed answers to the following questions.

①- Describe the structure of kidneys in human beings.

Answer:- See question No-9, at page No-38

②- why plants excret? what are the different mechanisms through plants excrete different substances.

Answer:- See Question No-4, at page No-31

③- what are kidney stones and How they are formed. Suggest which through these stones are removed from the body.

Answer: see question No-14, at page No-45

④- Define Haemodialysis. How is it performed?

Answer :- See question No-16, only part-1, page-49

⑤- How does dialyzer work?. Relate the function of dialyzer with that of the Kidney.

Answer :-

Dialyzer :- Definition :-

A filter (mechine) that act as an artificial kidney to clean blood is dialyzer.

Work :- Dialyzer contains a Artificial Semi-permeable membrane which allow Selected material to pass through it from blood of patient through diffusion process.

Dialyzer Vs Kidney :-

Dialyzer mechine work on the same principle as natural kidney for removal of the nitrogenous wastes and excess water from the blood. It is used after kidney failure.

— End —

Unit-12

Coordination and Control

(Q-1:) what is coordination. Explain it in organisms.

Answer:- Coordination :

Definition :- The cooperative working of cells, organs and systems with one another to perform proper functions is called coordination.

Cordination in organisms :-

In living organisms there are two types of coordination Animals possess both these types of coordination. plants and other unicellular organisms and fungi have only chemical coordination. i.e-

(1)- Nervous Coordination :-

Definition :- The coordination which is brought about by the nervous system is known as nervous coordination.

Explanation :- Nervous coordination composed of Specialized cells called Neurons, which detect and receive stimuli from receptors and then transmit it into central nervous system for analysis, and then transimt it from CNS to effector (i.e-muscles or glands) for response in the form of electric signals called Nerve impulse.

(2)- Chemical Coordination :

Definition :- The coordination which is brought about by the chemicals is called chemical coordination.

Explanation :- In this of coordination a group of cells called endocrine gland (ductless gland) releases specific chemicals called Hormones directly into blood, which regulate the activities of other target cell or organ of the body. This type of coordination is much more slower than nervous coordination. They work with the speed of blood in the blood vessels.

(Q-2:) Explain the process or Mechanism of coordination.

Answer: Mechanism of Coordination:

The process of coordination occurs in three phases. i.e—

①- Reception of Stimulus:

Stimulus :- Any change in Envirom̃ent which can initiate a response in the body is called stimulus.

Example :- touch, light and sound etc, are stimulus.

Receptors :-

"Those parts of the body that receive stimuli from Internal or External environment are called receptors."

Example :-

Receptors are specialized cells, structure, sense-organs, or ends of neurons which can detect any change

in the external or internal environment of the animal. The information collected by the receptors is then transmitted to the CNS for analysis and to develop response.

②- Analysis of information :-

→ The sensory impulses from various receptors are received by controlling centre called CNS (Brain + Spinal cord)

→ After collection of sensory information the controlling centre (i.e- CNS) analizes the information with the help of associative neuron. while in chemical coordination, endocrine glands are the coordinators. they receive information in the form of chemicals and send massages by secreting hormones in blood.

③- Response to stimulus :

→ After analysis of sensory information the analyzed information is send to effector (i.e- muscles or glands) through motor neuron for response.

→ "Those organs or structures which give response when stimulated by nerve impulse is called Effector."

Example :

when the door of our house is knocked. our receptors (i.e- ears) receive the sound wave and send this information to our brain. our brain makes a decision.

Then brain orders the effectors (i.e-muscles) of our legs to move to the door. Then signals are communicated to the hands and we open the door.

(Q-3) Differentiate between two types of coordination system.

Ans:

Character	Nervous coordination	Chemical coordination
①- Mode of coordination	in Electric form	in Hormonal form
②- Receptors	mostly sense organs e.g- eyes, ears, nose, skin	many body parts. e.g- Kidney, liver.
③- Coordination	controlling centre is Brain and spinal card.	controlling centre is endocrine glands.
④- Effectors	may be muscle or glands	many body parts e.g- Kidney and liver.
⑤- Nature of message	in Electric form	in chemical form.
⑥- carrier of massage	Neuron act as carrier	Blood carry Hormones
⑦- Nature of response	→ contraction of muscles → Secretions from glands	→ various types e.g- growth, reabsorption by kidney.

(Q-4:) write note on human Nervous system.

Answer: Human Nervous System:

introduction :- The Nervous system of human is the most complex and Advance among other animals. it is

divided into central Nervous system and peripheral Nervous system (PNS).

Division of human Nervous System :-

①- Central Nervous System :- (CNS) — central Nervous system of human is coordinating centre which lies in the mid line of the body. CNS consists of brain and Spinal cord. brain is involved more in coordination than Spinal cord.

②- peripheral Nervous System :- (PNS)

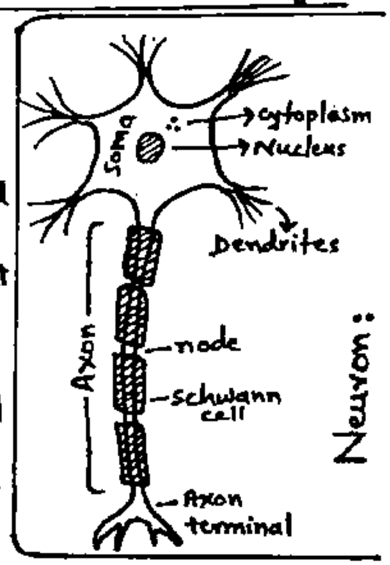
A network of nerves which arises from CNS and connect various parts of the body with CNS, constitute peripheral Nervous System. these nerves may either arise from brain or Spinal cord.

(Q-5:) what is Neuron, write the structure of typical Neuron.

Answer: Neuron:

Definition :- Neurons are specialized cells which have the ability to conduct nerve impulses. OR

The chief structural and functional unit of the nervous system is called neuron.



Structure of Neuron :- A typical neuron has 3-main parts i.e

①- Cell body : (Soma) -- The cell body is the main nutritional part of the neuron and is concerned with the biosynthesis of materials necessary for the growth and maintainance of the neuron.

Cytoplasm and organelles :- each neuron cell body consists of cytoplasm and nucleus. The cytoplasm also contains different organelles such as -- Endoplasmic reticulum, golgi-bodies and ribosomes.

② Dendrites :- Dendrites are those cytoplasmic processes which conduct impulses (message) towards the cell body of neuron. dendrites are generally short with many branches. The dendrites often have a spiny look.

③- Axon :

Axon is a long, single and unbranched cytoplasmic extension of neuron which carries impulses away from cell body.

Schwann cells :- Axon are usually covered by Schwann cells which are strip like cells wrapped around the Axon fiber.

Myelin Sheath :- Schwann cells are also covered by a fatty layer called myelin sheath which acts as insulator layer. due to myelin sheath the Axons are called myelinated fibers.

Node of Ranvier :- Between the two schwann cells,

there is a small non-myelinated portion of Axon called node of Ranvier.

Axon terminals:- At the terminal end of axon many fine branches are present, called Axon terminals.

(Q-6:) write the different types of Neuron.

Answer: Types of Neuron:—There are three types of neurons on the basis of function. i.e—

①- Sensory Neuron:- "—Those neurons which carry impulse from receptors towards the central nervous system are called sensory neuron."

→ They have a short axon and a single long dendron. The cell body is present at the side.

②- Motor neuron:- "Those neuron which carry message in the form of nerve impulse from CNS towards the effectors (muscles/glands) are called motor neuron."

→ The cell body is in the length of the neuron. They have short dendrites but a long axon.

③- Associative Neuron:- "Those neurons which conduct message from sensory neurons to motor neurons are called associative or inter-neuron."

→ They are found in the CNS and make brain and spinal cord. They have short but numerous dendrite. The Axon may be short or long.

(Q-7) What is Nerve, write it types.

Answer: Nerve

Definition:- The nerves are the bundle of Axons and dendrites bounded by connective tissues.

Function:- All the communication between receptors to the CNS and from CNS to the effectors is carried by the nerves.

Types of Nerves:-

①-Sensory Nerves:- Those Nerves which only carry imp-ulses from receptors towards CNS are called Sensory Nerv
→ these only contain dendrites of Neurons.

②-motor Nerves:-

Those Nerves which carry impulses from CNS towards effectors are called motor Nerves.

→ These only contain Axons of neuron.

③-Mixed Nerves:- Those nerves which carry impulses from receptor to CNS and from CNS towards effectors are called mixed nerves.

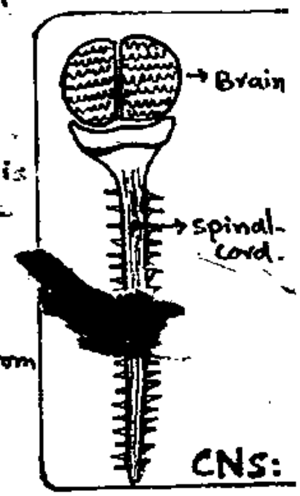
→ These nerves contain both Axons and dentrites.

> In certain parts of body, the cell bodies of Neurons form groups envloped by membranes. The groups of cell bodies are called ganglia.

(Q-8:) what is central Nervous system (CNS).

Answer: Central Nervous System:

Introduction:- Central nervous system of human is coordinating centre which lies in the mid line of the body. CNS consists of brain and spinal-cord. brain is involved more in coordination than spinal-cord. spinal-cord also act as a link between peripheral nervous-system and brain.



protection of CNS:- central nervous-system (i.e- Brain and spinal-cord) is highly sensitive parts of human body. There are different structures which protect the brain and spinal-cord from mechanical stresses. i.e—

a)- **Cranium:-** It is the part of skull which covers and protects the brain.

b)- **Vertebral column:-** The vertebrae of vertebral column protect the spinal cord.

c)- **Meninges:-** It is a System of membranes which surrounds the CNS. it is consists of three layer.

d)- **Cerebrospinal fluid:-** The fluid which is found in th membrane of brain and spinal-cord is called cerebr-spinal fluid, which protects the brain and spinal cord from mechanical shocks.

(Q-9:) Describe the structure and function of human brain.

Answer: Human Brain:

Introduction:- Brain is the main coordination centre which coordinates the actions at the right time and right sequence and place. It is also known as information storage centre, which is located in the cranial cavity of skull.

parts of brain:

Human brain is divided into three main parts. i.e-

①- Fore brain:- It is the first and largest part of brain which contains several millions neurons. fore brain is further divided into 3- parts. i.e-

ⓐ- Cerebrum:- cerebrum is the largest part of brain having many folds. It is divided into two cerebral-hemi--sphere. i.e- Right and Left cerebral hemisphere. The right cerebral hemisphere controls Left side of the body and left cerebral hemisphere controls right side of the body. Both cerebral hemispheres are connected by means of a large band of axons, called "Corpus callosum". The outer region of cerebrum is called cerebral cortex, while the inner region is called cerebral medulla.

Functions of cerebrum:

1- it is the controlling centre of sight, hearing, smell, taste and speech.

.- It controls the most of the volunt■ry muscles.

)- It is responsible for memory, intelligence, reasoning and judgment.

)- **Thalamus :-** It lies just above the mid brain and completely covered by cerebrum. It acts as a relay station between the body and cerebrum.

unctions:- 1. Thalamus receives impulses from different sensory areas of the body and passes them to cerebrum.

--Thalamus also controls pleasure and pain.

)- **Limbic system :-** The limbic system is located in an Arc between the thalamus and cerebrum. The limbic-System works together to produce our most basic and rimitive emotions, drives and behaviours.

arts of limbic system :- The limbic system consists :- Hypothalamus, Amygdala and Hippocampus.

- Hypothalamus lies below the thalamus which control e production of pituitary gland hormones.

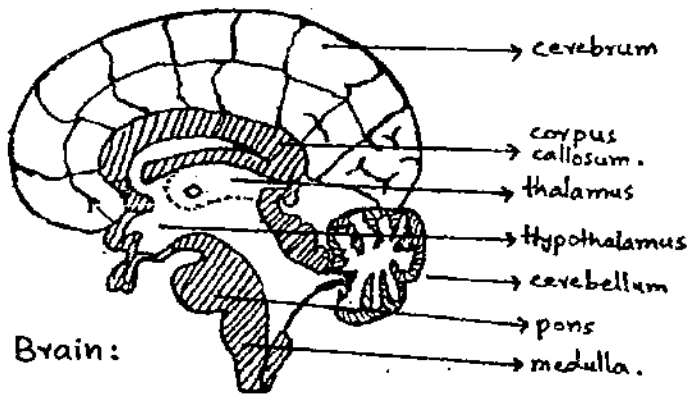
unctions:-

- Limbic system is the centre of most [illegible] emotional behaviours, such as— Love [illegible] hunger, thirst, sexual responses, fear, rage, pleasure, etc.
- It is also important in the formation of memories.

)- Mid brain:

It is present at the lower side of cerebrum between two hemisphere. mid brain is reduced in human. its walls are thick and it has a small central cavity. It receives the information of odour and vision.

Functions:- 1. mid brain is a relay centre that



-connects forebrain with hind brain.

2- mid brain also contains auditory relay centre.

3- It controls reflex movements of eyes and hearing reflexes.

③- Hind brain :

It is the last lower portion of brain which consists of the following parts.

ⓐ- Cerebellum :- It is the second largest part of brain, present at the lower region of brain. cerebellum consists of three lobes. Two Lateral Lobes and one central Lobe.

Functions:- 1: cerebellum controls muscular activities.

2- It guide smooth muscles and also causes accurates

movement possible.

3. It maintains body position or balance of the body.

(b)- pons :- It is a small Lobe like structure lies above the medulla oblongata.

Functions:- 1- pons act as bridge for the conduction of impulses.

2- pons also regulate the rate of breathing.

3- pons also influence the transitions between sleep and awakeness.

(c)- Medulla oblongata :- medulla oblongata is the lowest part of brain. It is broad at the upper side and becomes narrow towards lower side. It is connected to the spinal cord.

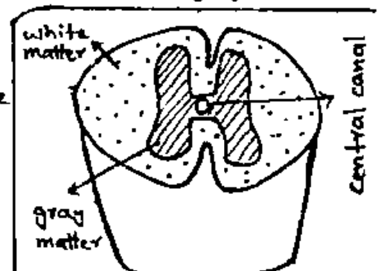
Functions:

medulla oblongata controls many reflex actions — such as — Heart beat, respiration, blood pressure, caughing, sneezing, Swallowing, vomiting, digestion, peristalsis, etc.

> medulla oblangata, pons, and midbrain connect the rest of brain to spinal card. they are collectively called Stem of Brain.

(Q-10:) write the structure and Function of spinal cord.

Answer: Spinal cord:



Spinal cord: (T.S)

Introduction :- spinal cord is the part of central nervous system which runs through the vertebral column. It is elongated hollow

and cylindrical structure which is about 18-inches in length and half-inch in width.

Structure :- In a cross section, the spinal cord shows two-portions. i.e-

①-Inner portion :- It is a butterfly shaped grey matter containing a central canal. Grey matter, as in other parts of nervous system consists of cell bodies and non-myelinated nerve fibres.

②-Outer portion :- It is composed of white matter. White matter made up of myelinated nerve fibres.

Spinal Nerves :-

There are 31-pairs of Spinal Nerves that arise from the Spinal cord. All the Spinal nerve are mixed nerves because each contains axons of both sensory and motor neurons. each Spinal nerve arises by two roots. Both roots unite and form the mixed spinal nerves.

Function of spinal cord :

1- Spinal cord control reflex actions below the neck region.
2- The dorsal portion of spinal cord conducts sensory impulses from receptors to brain.
3- The ventral portion of spinal cord carries motor impulses from brain to effectors.

4- It receives commands from brain and control functions accordingly in the trunk region.

(Q-11) What is peripheral Nervous System, write its Division.

Answer: peripheral Nervous System:-

Introduction:- A network of nerves which arises from CNS and connect various parts of the body with CNS, constitute peripheral Nervous system. these nerves may either arise from brain or Spinal cord. i.e-

1. Cranial Nerves:- The nerves which arise from brain are called Cranial Nerves. Humans have 12-pairs of cranial nerves. Some cranial nerves are sensory, some are motor and some are mixed.

2. Spinal Nerves:- The nerves which arise from Spinal cord are called Spinal Nerves. Humans have 31-pairs of Spinal Nerves. All Spinal Nerves are mixed.

pathway of conduction:-

The cranial and Spinal Nerves make two pathways i.e-

(a)- Sensory pathway:- which conducting impulses from receptors to CNS.

(b)- motor pathway :- which conducting impulse from CNS to effectors.

Systems of motor pathway:- motor pathway make two system i.e-

(1)- Somatic Nervous system :-

It controls conscious and voluntary actions. It includes — all of the motor neurons that are connected to skeletal muscles.

(2)- Autonomic Nervous System :-

It controls the involuntary functions of internal organs. It consists of motor neurons that are connected to cardiac-muscles, smooth muscle and glands.

Systems of Autonomic Nervous System :-

Autonomic nervous system consists of two systems i.e—

(1)- Sympathetic Nervous System :-

Definition :- The type of autonomic Nervous System which controls various autonomic function of the body during the state of emergency is called sympathetic N. system.

→ It stimulate or prepares the body for fight or flight during emergency or danger time.

Functions:-

1- It quickens breathing rate 2- Increases heart beat.

3- Dilates pupils of eye 4- Inhibit digestion.

5- rise in blood pressure.

②- parasympathetic Nervous System :-

Definition :- The type autonomic Nervous System which controls various autonomic functions during the state of rest is called parasympathetic N. system.

→ it returns the body functions to normal after they have been altered by sympathetic Nervous System.

Functions :-

1- promotes diagestion 2- Slow down heart beat.

3- contraction of pupils of eye 4- lowering of blood pressure.

(Q-12:) Explain how reflex action in human body works?

Answer :- Reflex action :

Definition :- An immediate, quick, automatic, involuntary response of the body to environmental changes is known

The Digestive system ⟨secretion of saliva⟩ is an involuntary system as it works on its own like blinking of eyes.

as reflex action."

Controlling centre:- Those reflexes which occur in head region are control by brain, while those reflex actions which are below neck region are controlled by spinal cord.

Reflex-Arc:

"The pathway of nerve impulse during reflex action is called reflex Arc." Reflex arc is the path for the conduction of nerve impulses from receptors to the CNS and from CNS towards the effector in reflex action.

Work of Reflex Arc:- A reflex consists of all the basic component of nervous system. i.e →

①- Receptor:- when our hand touches the sharp pointed object, pain sensitive ending of sensory neurons present in the skin are stimulated.

②- Sensory Neuron:- The sensory neuron transmits impulse to spinal cord.

③- Associative neuron:- when impulse reaches to spinal-cord, the associative neuron are stimulated and message transmits from sensory neuron to motor neuron.

④- Motor neuron:- After receiving the message from motor neuron, the axon of the motor neuron carries impulse to the effector i.e- to the bicep muscle of arm.

⑤- Effector:- when the message reaches to effectors (bicep muscle). The effector give response in the form

of contraction, as a result the hand is drawn from damaging stimulus (Sharp pin)

Examples of reflex action:

1- with drawal of hand or leg by touching a hot surface or a sharp pin.

2- Blinking of eyes when a dust particles touches the cornea of eye.

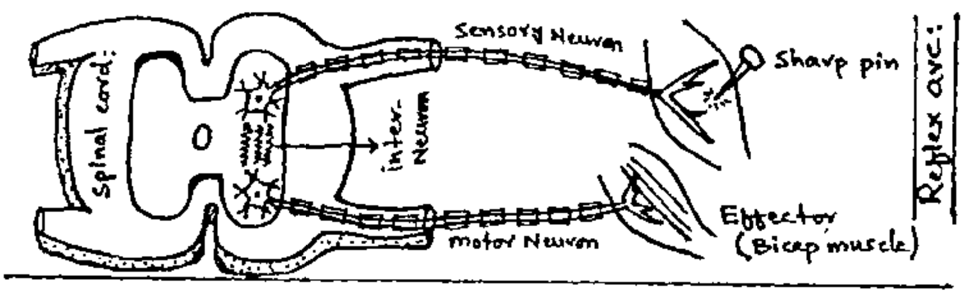
3- watering of the mouth at the sight or smell of food.

Importance of Reflex action:

1- It reduces burden on the brain.

2- It helps us to save our body from damages.

3- It helps us to react to environmental changes.



(Q-13:) Define receptor, write the name of different types of receptors in Human body.

Answer: Receptor:

Definition:- Receptors are the structures or organs which receive the changes taking place in our environment.

Receptors in Human body:- In human body there are many types of receptors which perform different functions.

such as—

①- **photoreceptors**:- These detect light stimulus. eg- eyes.

②- **Sonoreceptors**:- These detect sound waves. e.g- ears.

③- **Chemicalreceptors**:- These detect different chemicals Stimuli e.g— tongue and nose.

④- **Mechanical receptors**:- These detect pressure and are mostly found in the skin.

⑤- In addition to the above, there are also other types of receptors which feel pain, hunger, thirst, pleasure, emotions, etc.

(Q-14:) What are photoreceptors? Explain the Structure of Human eye.

Answer: photoreceptors:- Those receptors which detect Light are called photoreceptors or visual receptors.

Human eye as a photoreceptor:

Eye is the organ used as photoreceptor. It is the sense organ of sight that receives the sensory information in the form of light. It is located in a bony soket called orbit. A pair of eye is present in human being. They are oval in shape. The eye is protected by the eyelids.

Structure of Human eye:

The eye ball is made up of three layer. i.e—

①- **Sclerotic: (Musclar layer)** — It is the outer most

white, tough, muscular layer which covers the eye from outside.

Cornea :- It is the anterior, transparent and bulging portion of the eye. It receives the light rays from outer environment.

②- Choroid :- (Vascular Layer)

Choroid is the middle and vascular layer of the eye. it contains blood vessels which give nourishment to eye.

→ The parts present inside the choroid is—

ⓐ- Ciliary body :- The choroid layer is thick in the anterior part and makes the ciliary body.

ⓑ- Iris :- It is the coloured part of the eye present behind the cornea. It may be blue, black, brown and green, etc. It gives a color to eye.

ⓒ- Pupil :- it is a small opening or window in the middle of the iris. it controls the amount of light entering the eye.

ⓓ- Lens :- Human eye have biconvex lenses present behind the iris. it is held by suspensory ligment at the side. lens focuses the light rays on retina.

ⓔ- Aquous humor :- The region between lenses and cornea is filled by a liquid called aquous humor. it maintains the shape of the eye and control light intensity.

③- Retina :- (Nervous layer)

It is the third innermost and sensitive layer of the eye. it is composed of special types of neurons called - Rods and Cones. These cells are photoreceptors. i.e—

ⓐ- Rod :- Rod cells work in dim light and can produce black and white image. In human retina rods are more than cones. It contain a purplish-red pigment called Rhodopsin, that synthesis from vitamin-A.

ⓑ- Cones :- cones work only in bright light and can produce colour image. It also contain a pigment, called Idopsin. There are three types of cones. Each contains Specific Iodopsin for red, green or blue light.

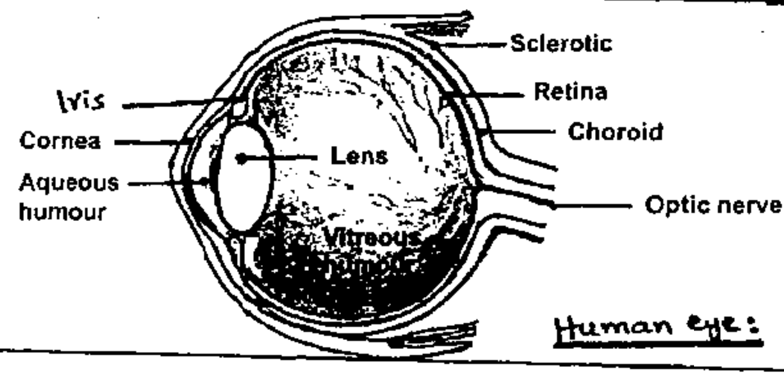
ⓒ- Fovea :- It is the part of retina which has the largest number of rods and cones so produces the most clear image. It is also called yellow spot.

ⓓ- Blind spot :- It is the part of retina from which the optic nerve arise. It does not contain rods and cones. it is insensitive to light and no image is produced here.

ⓔ- Optic Nerve :- it is the nerve which arise from the retina and carry impulses from retina to brain.

ⓕ- Vitreous humor :- The space between the lens and

retina is filled by a jelly like substance called vitreous humor. it is nutritive in function and also give shape to eye.



Human eye:

(Q-14:) Explain the mechanism of vision by eyes.

Answer: Mechanism of Vision:-

1- The light rays coming through the cornea and lens make image on the retina.

2- The photoreceptor cell i.e- Rods and cones of retina produce nerve impulse in the neurons present in retina.

3- The Axons of these neurons are part of the optic Nerve.

4- The optic nerve carries information in the form of nerve impulse from the retain to the cerebrum of brain.

5- Hence, the impulses are processed to produce a meaningful sensation of shape and colour.

(Q-15) Discuss any two disorders of Human eye.

Answer: Disorders of eye :- sometimes a defect occurs in the working of eyes which causes great disturbance in the Life of a person. Some of these disorders are very Serious and Lead to blindness but some disorders are easily curable. Two common disorders of human eyes are explain here. i.e-

①- Short sightedness:

Definition :- "It is the type of eye disorder in which a person can see near object but can not see far object clearly." → It is also called Myopia.

Causes :- This disease is caused by the enlargement of eye ball which makes light rays focus in front of retina, instead of focusing on the surface of the retina.

Treatment :- ① This disease can be corrected by wearing glasses having concave lenses. This lens focuses the rays on the retina and the person is again able to see.. correctly.

2- This disease can also cured with laser eye surgery. In which a laser is used to reshape the cornea to correct its curve.

②-Long sightedness:

Definition :- It is a type of eye disease in which a person can see far object but can not see nearer

object clearly. → It is also called Hypermetropia.

Causes :- This disease is caused by short eye ball which focus light rays behind the retina, instead of focusing on the surface of the retina.

Treatment : ① It is treated by using glasses having convex lenses. This lens focuses the rays on the retain and the person is again able to see correctly.

2- This disease can also be cured with laser eye surgery in which laser is used to reshape the cornea and improve the curve.

(Q-16) Discuss the contributions of muslim scientists in opthalmology.

Answer : ①- Ibn-Al-Haitham :-

Introduction :- Ibn-Al-Haitham is the most famous scientist in the muslim world. His full name was — Abu-Ali-al-Hasan ibn-al-Haitham. In west he was known by Alhacen or Alhazen. He was born in 965-A.D. in Basra and died in 1040-A.D. in cairo.

Contributions :

- Kitab-ul-Manazir :— (Book of optics)-

1- He is regarded as the father of modern optics for his famous book — Kitab-ul-Manazir.

2- This book has seven massive volumes, these were written from 1011 to 1021.

3- He conducted expermints in different fields of optics, including— Lenses, mirrors, reflection, refraction, and dispersion of light in seven colours.

4- He describe the finite shape of light.

5- He postulates that light is made of particles, travelling in straight lines.

6- He described the structure and function of eye.

7- He was the first person who rejects the old concept of sight that rays come out of eye to see the object. He proved that it is light ray which reflect from objects and enter the eye to make image.

8- He studied binocular vision and the moon illusion.

9- He made the first camera, the pin hole camera.

②- Ali-Bin-Isa :-

Introduction :- Ali-Bin-Isa was born in 9th century in 940-A.D. in Bagdad and died in 1010-A.D.

Contributions :

- **Tashkirat-ul-Kahhalin : (Note book of oculist)**

1- He wrote - Tashkirat-ul-Kahhalin.

2- This book is mostly based on his personal observation.

3- The book contains information on the treatment and

classification of over one hundered different eye diseases.

4- This book was translated in Latin in 1497. Afterward it was also translated in German and english.

5- This book was widely used by European physicians for hundreds of year.

(Q-15:) what is sonoreceptor, Describe the structure of Ear.

Answer: Sonoreceptor :- (Audio-receptor)

Definition :- Those receptors which detect sound wave are called sono-receptors or audio-receptors.

→ Sono-receptor of human body is "Ear."

Structure of Human Ear:

Human ear can be divided into three main parts. i.e—

(1)- External Ear:-

The outer most part of ear is called external ear. it consists of ear-pinna, and auditory canal. i.e—

(a)- Ear pinna :- It is the outermost delicate, flexible and cartilaginous flap of ear. It catches sound wave from outer environment.

(b)- Auditory canal :- It is a tube that helps to direct sound waves from the pinna to the ear-drum. it contains hairs and wax which trap dust particles and small insects from entering to inner ear.

(2)- Middle Ear :- it is a small chamber separated.

from outer ear by the ear-drum. It is composed of a set of three bones which are collectively called - Ossicles. The three bones are - Malleus (Hammer shaped), Incus (Anvil shaped) and Stapes (Stirrup shaped).

These bones are the smallest bones of the body.

Function:- These bones carry vibrations of the ear-drum to the inner ear.

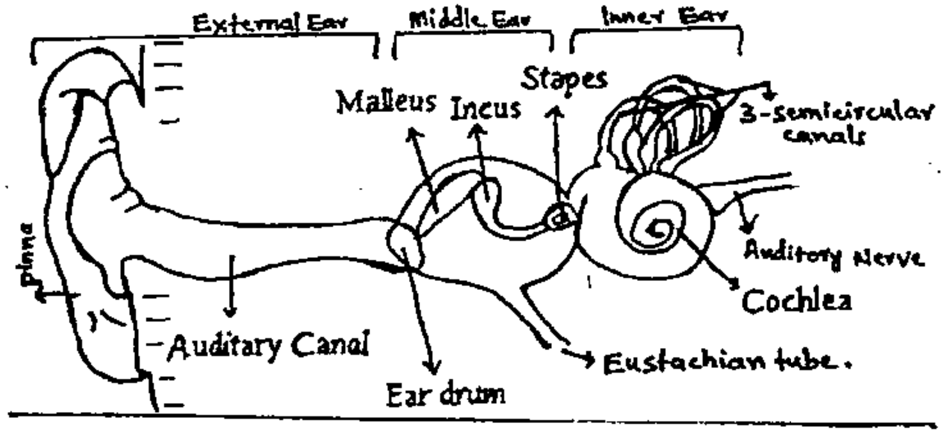
Eustachian tube:- It is a tube which connect the middle ear to the pharynx. It maintains the air-pressure inside the ear.

③- Inner Ear:- The inner ear lies in a cage known as bony labyrinth. It is filled with a fluid called endolymph. Internal ear consists of - Cochlea, Vestibules and three Semicircular canal. i.e-

ⓐ- Cochlea:- It is the real hearing organ. It is spiral in shape. Auditory nerves arising from cochlea. The middle chamber of cochlea has the hearing apparatus, called the organ of corti. Special hair cells are present in the organ of corti, which are the receptor cells for sound.

ⓑ- Vestibules:- It is the middle part of the inner ear which maintains the balance of the body. The nerves arise from vestibules are called Vestibular nerves.

ⓒ Three Semicircular canal:- These are the three canal located at right angle with each other. It gave senses about position and balance of the body.



Q-18: Explain Function of Ear. / How ear help in Hearing and Balancing of body.

Answer: Function of Ear:

1- Hearing of sound :- sound waves are collected by the pinna and reach the ear drum. The ear-drum starts vibrations. These vibrations are transmitted to the endolymph present in the cochlea through the ossicles. Movement in the endolymph stimulate the sensory cells which produce impulses. These impulses are carried to the brain through auditory nerve. The brain interprets them as sound.

2- Balance of the body :- when we move or bend the endolymph in the three-semicircular canals also changes its position and stimulate the receptors cells to produce impulses. These impulses are carried to the brain through auditory nerve. The brain makes us aware of our body position. we can adjust our position and balance of our body.

(Q-19) write a comprehensive note on chemical coordin-
-ation in human beings.

Answer: Chemical coordination:

Definition :- The coordination which is brought about by the chemicals (Hormones) is called chemical coordination.

Explanation :- In this kind of coordination a group of cells called endocrine gland (ductless gland) releases specific chemicals called Hormones directly into blood, which regulate the activities of other target cell or organ of the body.

Endocrine gland :- (ductless gland)

Those glands which secrete their secretion directly into blood stream is called endocrine gland."

There are about 20-endocrine gland in human body.

Example :- pituitary gland, thyroid gland, Adrenal gland, etc.

Hormones :-

Meaning :- Hormone is a Greek word - "Hormon" which mean - exciting or sitting in motion.

Definition :- Hormones are the organic substance, produced by endocrine glands which regulated or inhibite the particular function.

Secretion of Hormones :- Endocrine glands produce hormones and secrete by exocytosis directly into the.

the extracellar spaces. from there the hormones enter the blood or lymphatic fluid and travel to specific target site. → Most hormones are chemically proteins but some are derivatives of fatty acids. i.e— steroid.

Work of hormones : (Function):

1- The Hormones affect the target cells. They donot initiate new biochemical reactions. However they regulate enzymatic and other chemical reactions, already present.

2- They may either stimulate or inhibite a function.

3- Hormones may also control some long term changes, such as — rate of growth, rate of metabolic activity and sexual maturity.

many gland have ducts for their secretion called Exocrine gland. e.g- digestive glands.

(Q-20:) Describe the role of different hormones produced by pituitary gland.

Answer :- pituitary gland :

Location :- pituitary gland is located in the brain, under the hypothalamus. Its functions are controlled by hypothalamus.

Colour :- pituitary gland is red grey in colour.

Size and shape :- it is about the size of a Large pea. it is ovoid in shape.

Weight :- It is about 0.5 gm in adult human.

Lobes :— pituitary gland consists of three lobes. i.e-

(1)- Anterior Lobe :-

The anterior lobe of pituitary gland is considered the master gland of the endocrine system because it secretes a large number of hormones which control the other endocrine glands.

Secretion of anterior lobe :- It secretes the following different types of hormones.

(a)- Growth Hormones :- (GH)

1- Growth hormone has a direct effect on growth and development of all the body parts.

2- It stimulates and control growth of the body and Skeleton during childhood and Adolescence.

Abnormalities :- Over-secretion of growth hormone during early life causes gigantism (Tallness) while its under-secretion results in dwarfism. (dwarf or short body)

(b)- Thyroid stimulating hormones : (TSH)-

1- It controls the development and functioning of thyroid gland.

2- TSH also stimulates the thyroid gland to secrete thyroxin hormone.

(c)- Adrenocorticotropic hormones :- (ACTH)

1- It stimulates the growth of Adrenal cortex.

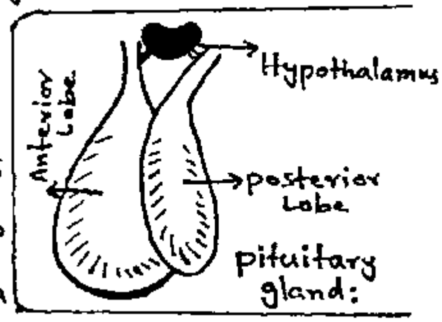
2- It also stimulates adrenal cortex to secrete — glucocorticoids and Androgens.

(d)- Gonadotrophic Hormones :- These hormones act on gonads and helps in their development and functions. for example Luteinizing Hormone, which help in gametes formation and sex-Hormones production.

(2)- posterior lobe:

It secretes the following different types of hormones.

(a)- Antidiuretic hormone: (ADH) – ADH stimulates the reabsorption of water from glomerular filterate in distal part of nephron.



pituitary gland:

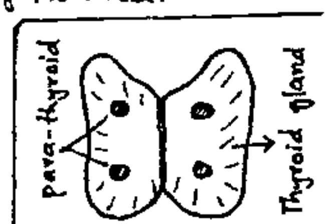
(b)- Oxytocin :-

It causes strong contraction of uterine muscles during birth to expel the baby out and placenta after birth. it also stimulates the flow of milk from breasts during laction.

(Q-21:) Describe the role of hormones secreted by the thyroid gland.

Answer: Thyroid gland :-

Location :- Thyroid gland is present in the lower region of neck (below the larynx) in front of trachea.



Thyroid gland:

Shape :- It is butterfly shaped.

Weight :- It is about 20 to 25 gm.

Lobes :- It consists of two lobes.

Secreection :- it secrete two Hormones.

i.e –

① - Thyroxin :-

1- It increases the metabolic rate and produce heat in the body.

2- It also promote growth and sexual and metal development.

Control of thyroxin :- Thyroid gland needs iodine for the synthesis of thyroxine hormone.

Abnormalities :

1- less Secretion :- If thyroxine is produced less than the required amount, cellular metabolism slows. It results in lethargy, weight gain, and low heart rate and body temperature.

2- Over Secretion :- If thyroxine is produced more than required, cellular metabolism become faster than normal. It results in weight loss, and high blood pressure, heart rate, and body temperature.

Goiter :- (Abnormalities of thyroxin)

production of thyroxin needs Iodine. If Iodine is not present in our food or water, the thyroide gland swells up. this condition is called Goiter. The enlargement of thyroid gland due to deficiency of iodine is called goiter.

Treatment of Goiter :- Table salt with iodine is recommended so that there is no deficiency of iodine and thus of thyroxin in the body.

(2)- Calcitonin :- calcitonin controls the extracellular levels of calcium ions, (Ca^{+2}). It stimulates the transfer of calcium ions from blood to bone, where the calcium ions can be used to generate bone tissue. In this way, calcitonin maintains blood calcium levels.

Diabetes is sugar metabolic disease which occur due to less insulin level.

(Q-22:) Describe the role of hormone produces by Islets of Langerhan's or pancreas.

Answer :- Pancreas :

Location :- pancreas is located in abdominal cavity near the stomach.

Dual nature :- The pancreas is a double gland as it serves both as exocrine and endocrine gland. i.e-

(1)- Exocrine like :- The bulk of the pancreas is exocrine which synthesize pancreatic juice. The pancreatic juice

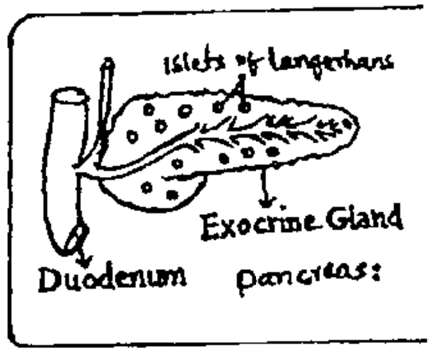
Note: Scientists now able to insert a human gene into bacterium. For example gene coded for the production of insulin is inserted into the plasmid of a bacterium. As the bacterium undergoes binary fissions bacteria with the insulin gene are then multiplied and each bacterium will produce a tiny volume of insulin.

is then delivered to the duodenum by pancreatic duct that help in digestion of food.

②- Endocrine like :- The islets of pancreas act as endocrine gland which secrete the insulin and glucagon hormones directly into blood that control the sugar level.

Islets of langerhan's :- There are clusters of cells, embedded in the pancreas tissue appear like islet called islets of pancreas or langerhan's.

Endocrine secretion:



ⓐ- Insulin :- It reduces the blood glucose level to the normal level in two way. i.e-

1- Glucose is converted into lipid and protein.

2- uptake of glucose by liver, muscles and adipose tissue is increased.

Abnormalities :- Insulin is secreted by the beta-cells of pancreas just after meals. If the body fail to produce insulin, it leads to a disease called — Diabetes mellitus or sugar.

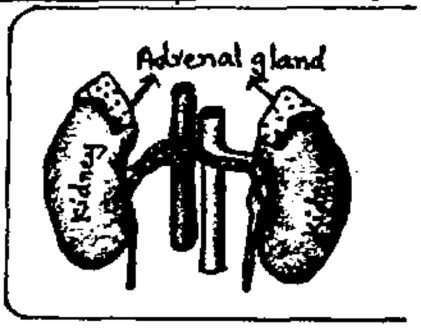
ⓑ- Glucagon :- Glucagon works opposite to insuline and increase glucose level in the blood. It is secreted by alpha cells in the time between the meals.

Function :- 1. Glucagon promotes the breakdown of

glycogen to glucose in the liver and muscles.

2. It also promotes the breakdown of fats.

(Q-23) Describe the role of hormone produce by Adrenal gland.



Answer: Adrenal gland :-

Location :- Adrenal glands are located on the upper ends of kidneys like caps.

Numbers:- Adrenal glands are two in number, present one on each Kidney.

Structure of parts :- Each adrenal gland is composed of two parts i.e- outer Adrenal cortex and inner medulla.

①- Adrenal cortex :-

It is outer reddish brown part of adrenal gland.

Secretion :- The secretion of adrenal cortex is under the control of ACTH secreted by anterior lobes of pituitary gland. It secretes different steroid hormones (about 50-different types) which are collectively known as corticosteroids.

Functions :- The corticosteroids hormones control the metabolism of minerals and glucose etc.

②- Adrenal Medulla :

It is the inner part of adrenal gland. it is greyish in colour.

Secretion:- Adrenal Medulla secretes two types of hormones. i.e- Epinephrine and nor-epinephrine.

Emotional hormones:- Both epinephrine and nor epinephrine hormones are collectively known as - Emotional hormones because these are secreted under situation of stress, Anxiety, fear, etc.

ⓐ- Epinephrine: (Adrenalline).

It is known as general Vasodilator because it Vasodilates blood vessels during emotions and prepares body for flight or fight during stress and emergency. (face become red)

ⓑ- Nor-epinephrine: (non-Adrenalline).

It is known as general vasoconstrictor because it Vaso-constricts blood vessels during emotions, in the gut and face. This why in fear the face becomes pale or white and hollow gut.

(Q:24) Describe the role of hormones produce by gonads.

Answer: Gonads:

Introduction:- Gonads are reproductive organs which are responsible for the formation of gametes, but gonads also acts as endocrine glands because its also secretes hormones.

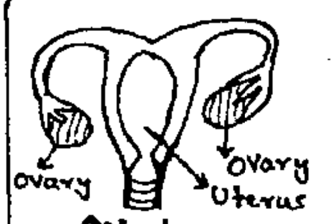
Types of gonads:

①- Ovaries:- Ovaries are female gonads. It not only produce female gametes (eggs) but also secrete female sex-hormones - i.e- Estrogen and progestrone.

ⓐ- Estrogen:-

1- Estrogen bring about the development of the secondary sexual characters in female.

2- It also causes thickening of the uterine wall.



Ovaries:

(b)- progesterone :

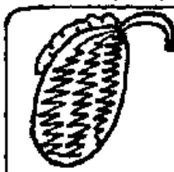
1- It causes thickness of uterus.

2- It also maintains pregnancy by preventing contraction of uterin wall till birth.

(2)- Testes :

Testes are male reproductive organs or gonads. it produces Sperms but also act as endocrine glands, produce testosterone.

Testosterone Hormone :-


Testis

1- In the foetus it initiates the development of the sex organs.

2- At puberty it brings about development of male Secondary sexual characters and promotes the sex drive.

(Q-25) Describe the mechanism of hormonal secretion

OR. Explain Negative feedback mechanism with Example.

Answer :- Mechanism of Hormonal secretion :

Different endocrine secretion act as a system of checks and balance for each other. For the proper function of the body, two opposing systems are required. If there are accelerators, there must be inhibitors. Same is

the case with hormones.

Negative feedback Mechanism :-

Definition :- An interaction in which the increasing amount of one hormone decreases the secretion of another hormone is called negative feedback mechanism.

Explanation with example :

1- A good example of negative feedback is with the hormone called insulin, that regulates blood glucose levels.

2- When we take a meal, the carbohydrates are digested and converted into glucose.

3- Glucose is absorbed into the blood from small intestine, thus increase Glucose level in the blood.

4- when this blood passes through the pancreas, the Islets of pancreas at once sense this increase and start secretion of insulin in the blood.

5- Insulin causes a reduction in the blood glucose by promoting their uptake into liver, muscles, adipose tissue, etc. Here the extra-glucose is converted into glucogen and is stored.

6- This causes reducation of glucose in the blood. when this blood passes through the Islets of pancreas, they feel this decrease and stop secretion of insulin.

(Q-26) Write note on Epilepsy and paralysis.

①- Epilepsy :- (Fits or Mirgi)

Definition :- A disorder of nervous system characterized by unconsiousness and violent movement of the body is called epilepsy.

Causes :- 1- Epilepsy is due to the abrupt excessive rapid electric discharge on the grey matter of brain.

2- Epilepsy may be caused by changes in the brain due to genetic reasons.

3. Severe head injuries, stroke, brain infections and drug abuse may also cause epilepsy.

Symptoms :-

1- First cries and falls unconsiously.

2- cleached hands. 3- Biting of tongue.

4- Frothing from mouth. 5- Throwing of hands and legs about

6- usually occur before 30-years of age.

Precaution :-

1- Do not Leave epilepsy patient alone, other wise he may fall and injured himself.

2- patient should be allowed to be quite and undisturbed.

3- Let go him to sleep.

4- Do not give patient any stimulant, such as Alcohols.

Treatment :- Anti-epilepsy drugs are used for the treatment of epilepsy.

②- paralysis :

Definition :- A disorder of nervous system characterized by complete loss of strength in an effected area of the body is known as paralysis.

Causes :- 1- Blood clotting inside the blood vessels of the brain. Thus the blood supply to the brain is reduced.

2- Due to high blood pressure the blood vessels in the brain ruptures and bleeding occurs. This condition is called brain hemorrhage. Due to this reason the parts of body controlled by this part of the brain stop functioning and results in paralysis.

Symptoms :-

1- The affected area of the body becomes senseless.

2- The patient of paralysis is unable to move muscles of one side of the body or of both sides.

3- paralysis may also affect the arms or the legs, and sometimes the whole body.

Treatment :-

1- Medicines are given to dissolve the clot.

2- physiotherapy of the affected parts can restore the normal functioning and movement.

3- Provide mobility Aid to patients.

Exercise

Q-A :) Encircle the best suitable answer.

1- Insulin is a hormone and is secreted by-

(a)- Liver ✓(b)- pancreas (c)- Stomach (d)- Both A, B

2- one of the following is a muscular layer of the eyeball.

(a)- Retina ✓(b)- Sclera (c)- cornea (d)- Cone.

3- The part of neuron that carrier the signals away from the cell body.

✓(a)- Axon (b)- Dendrite (c)- schwann cell (d)- myelin sheath

4- one of the following is responsible for the detection of changes in environment.

✓(a)- receptors (b)- neurons (c)- effectors (d)- All of them.

5- which of the following is true about the cerebral cortex.

(a)- It is located deep in the brain
✓(b)- it is the folded outer covering of the brain.
(c)- It is part of the peripheral nervous System.
(d)- It is located at the back of the brain.

6- Light rays focus behind the retina, instead of focusing on the surface of retina, the condition is known as—

(a)- myopia ✓(b)- Hypermetropia (c)- short sightedness (d) Normal vision.

7- microscopic gaps b/w the neuron endings are—

(a)- Transmitters ✓(b)- synapses (c) pores (d)- Nodes

(8)- The largest part of the brain is.

✓(a)- cerebrum (b)-cerebellum (c)-Thalamus (d)- Hypothalamus

(9)- Intelligence is under the control of-

✓(a) cerebrum (b)- cerebellum (c) thalamus (d) Hypothalamus

(10)- mixed nerves are made of-

✓(a)- Axons of sensory and motor neurons.

(b)- cell bodies of sensory and motor neurons.

(c)- Axons of inter-neurons. (d)- cell bodies of inter-neurons.

(Q-B:) write short answers to the following questions.

(1)- How reflex action works in human beings.?

Answer:- See question No-12, at page No-75

(2)- what are the causes of epilepsy and paralysis?

Answer:- See causes only of Q-No-26, at page-99,100

(3)- what will happen if Islets of langerhans secrete insulin but not glucagon.

Answer:- If Islets of langerhans secrete insulin but not glucagon. so the insulin level will be arise in blood, result the utilization of sugar will be too great and its level fall in the blood and such condition is called Hypoglcemia.

Symptoms of Hypoglycemia:-

1- Brain cells will be effected baceuse brain cells only use glucose.

2- low blood glucose level causes breakdown of muscle tissue.

3- loss of weight and triedness.

4- Severe depression in nervous system.

5- hunger, sweating, 6- irritability, double vision.

(Q)- why pituitary gland is known as master gland.

Answer: pituitary gland as master gland:-

Introduction :- The anterior lobe of pituitary-gland is considered the master gland of the endocrine system because it secretes a large number of hormones. Some of these hormones control body function directly and Some control other endocrine glands, that is why pituitary gland is called master gland of the body.

For example :-

Thyroid stimulating hormones, follicles stimulating hormone, Adrenocorticotrophic hormone and luteinizing hormone, which control the development and secretion of respectively gland.

⑤- Differentiate between two types of coordination system.

Answer: See question No-3, at page No-62

⑥- What is the role of insulin and glucagon.

Answer:- See question No-22, only Function of Insulin and Glucagon, at page No-94

⑦- What characters are controlled by ovarian Hormones?

Answer:- See question No-24, only Hormones of ovaries, at page No-96.

⑧- State the hormones of the pituitary and thyroid glands and write their functions.

Answer:- ① **Hormones of the pituitary gland:-**

Anterior lobe Hormones:-

1- Growth Hormone :- regulates development of muscles and bones.

2- ACTH :- Stimulates secretion of cortisol and aldosterone by adrenal cortex.

3- TSH :- Stimulate thyroid gland to produce thyroxine.

4- LH :- Stimulate ovary to release egg and stimulate the testes to produce Sex-Hormones.

Posterior lobe Hormones:-

1- ADH :- Increase reabsorption of water from nephrons.

2-oxytocin :- initiate uterine contractions during child-birth, and flow of milk from breast.

②-Thyroid gland Hormones :-

1-Thyroxine :- Stimulates enzymes of cellular metabolism

2-Calcitonine :- decreases blood calcium concentration.

⑨Q- label the different parts of brain in the following diagram.

Answer :- See Text book Exercise, and label by itself because it activity for students.

× × ×

Q-c) write detailed answers to the following questions.

①Q - Explain different types of receptors in human beings.

Answer :- See question No-13, at page No-77

②Q - Describe the structure of human brain.

Answer :- See question No-9, at page No-68

③Q - write a comprehensive note on chemical coordination in human beings

Answer :- See question No-19, at page No-88

(4) Q- Discuss any two disorders of human eye.

Answer :- See question No-15, at page No-82

(5) Q- Describe the cause, symptoms and treatment of paralysis.

Answer :- See question No-26, at page No-100

(6) Q- Describe the cause, symptoms and treatment of Epilepsy

Answer :- See question No-26, at page No-99

(7) Q- Explain the mechanism of vision by eyes.

Answer :- See question No-14, at page-No-81

—End—

Support and Movement

Unit -13

(Q-1:) What is skeleton. Describe the main division of Human skeleton.

Answer:- Skeleton:

Definition:- The skeleton is tough and rigid framework of the body of animals which provides protection, shape and support to the body organs.

Explanation of Human Skeleton:-

Like other vertebrates, the human skeleton is inside the body called Endoskeleton. It contains living cells and also has nerves and blood vessels. it can also grow and repair itself.

Human skeleton consists of bone and cartilage. at the birth time human have 350- bones in their body. But adults human body consists of 206- bones.

Division of Human skeleton:

Human skeleton can be divided into two parts. i.e-

(1)- Axial skeleton:

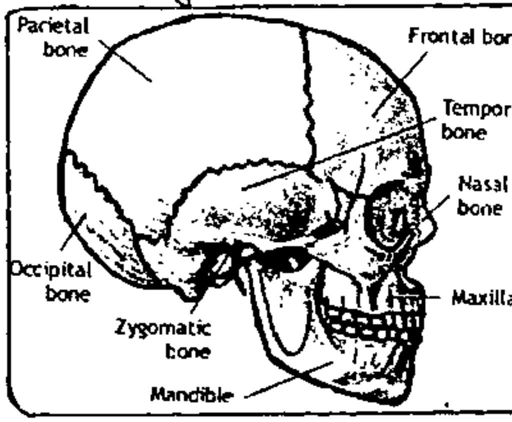
The skeleton which is present or located in the mid body is called Axial skeleton. It provides frame work to the body.

It consists of 80-bones.

Parts of Axial skeleton :- Axial skeleton consists of skull, Vertebral column and rib cage. i.e-

(a)- Skull :

The Human skull is composed of 22-bones (cranium and facial bones), beside 6-tiny ear bones and one neck bone. i.e-



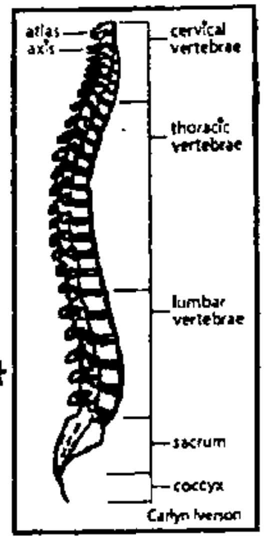
(i)- Cranium :- It consists of 8-bones, In which 4-bones are unpaired and two bones are paired. Its primary function is to protect the brain.

(ii)- Facial bone :- There are 14-facial bones of which 6-bone are paired and 2-bones are unpaired which form face.

(iii)- Ear bones :- There are 3-paired ear bone called ossicles, each ear contain 3-tiny bones i.e Molleus, incus and Stapes.

(iv)- Neck bone :- There is one bone in neck called hyoid bone.

> The skeleton of some invertebrates (e.g-Arthopods) is outside the body called exoskeleton.



(b)- Vertebral Column :- Vertebral column extands from the skull to the pelvis to form backbone, which protects the spinal cord. It is a rigid rod on the dorsal side of the trunk which provides axial support to the body. It provide attachment site for pectoral and pelvic girdle.

Vertebrae :- There are 33-Vertebrae in human. They are divided into four groups. i.e-

i)- Cervical Vertebrae :- There are 7-Vertebrae which lie in the neck region.

ii)- Thoracic Vertebrae :- There are 12- thoracic vertebrae located in the thoracic region.

iii)- Lumber Vertebrae :- There are 5-Vertebrae in lumber region.

iv)- pelvic Vertebrae :- There are 9-Vertebrae in pelvic region which form two set, Sacrum and coccyx. i.e-

→ **Sacral Vertebrae :-** First 5-Vertebrae of pelvic region are sacral vertebrae. These are fused together.

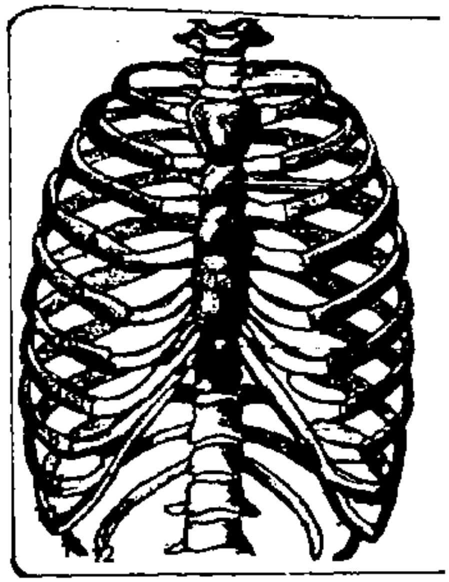
→ **Coccyx / tail bone :-** Last 4-fused pelvic vertebrae are called tail bones which is Vestigial (functionless) organ in human.

(c)- Ribs :

Rib cage : (chest box) - Rib forms rib-cage which

provides support to a semi-chamber called chest cavity. Rib-cage also protects the most sensitive part of body i.e- heart, lung, etc.

Ribs Number :- There are 12-pair of ribs in human. each pair is attached with each of the thoracic vertebrae dorsally but ventrally 10-pairs are attached with the sternum and two pairs are free called floating ribs.



②- Appendicular Skeleton:

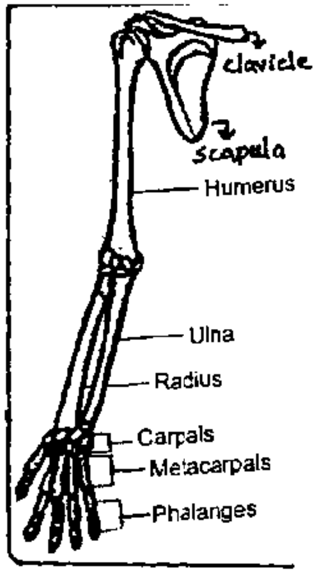
The skeleton which is located or present in limbs (appendages) is called appendicular skeleton. It consists of 126-bones.

parts :-

Appendicular skeleton consists of pectoral girdle and fore limbs and pelvic girdle and hind limbs. i.e

ⓐ- pectoral girdle : (The shoulder)- It is a appendicular skeleton which attachs fore limbs with axial skeleton. Each pectoral girdle consists of 3-bones i.e- Scapula, coracoid and clavicle.

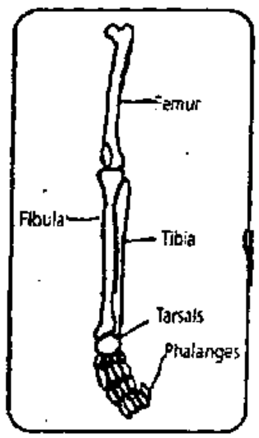
ⓑ Fore limbs : (The arms)- Fore-limb is attached to the pectoral girdle. It consists of about 30-bones. i.e- -A humerus in the upper arm region; a radius and an Ulna in the lower arm region; 8-carpels in the



wrist; 5-metacarpels in the palm of the hand and 14-phalanges in the fingers and thumb.

©- pelvic girdle :- (The hips girdle)-

It is appendricular skeleton which attaches the hind limbs (legs) with Vertebral column and support the pelvic region. It consists of two coxal bones. each is formed by the fusion of 3-bones. i.e- Ilium, ischium and pubis.



ⓓ- Hind Limbs :- (The Legs)-

Each hind limb consists of thigh, shank, ankle and foot. Each hind limb is consists of 30-bones. i.e-

A single femur in the thigh; tibia and fibula in the shank; 8-ankle bones; 5-metatarsels in the foot and finally 14-phalanges in toes.

Q-2: write the function or role of the skeletal System.

Answer: Functions of Skeleton: - The Skeleton performs the following functions in the body.

1- **Support and shape :-** Skeleton provides support to soft tissues of the body. It provides attachment sites for muscles. It also gives proper shape to the body.

2- **protection :-** Skeleton protects various sensitive internal organs. e.g- brain, spinal card, lungs and heart.

3- **Movement :-** Skeleton helps in movement of organs and Locomotion of organisms, due to muscles and joints.

4- **Breathing :-** Skeleton helps in breathing.

5- **Hearing :-** Several bones in the ear help in hearing.

6- **Bone Marrow :-** Blood cells are produced in the bone marrow of certain bones.

7- **Store minerals :-** Bones store mineral salts. e.g- calcium, potassium, phosphorus.

(Q-3:) write the Composition of human Skeleton.

Answer : Composition of Human Skeleton:

The human skeletal system consists of bones and cartilages of various types. i.e-

(1)- Bone :-

Introduction :- Bone is a rigid form of connective-tissue. Bone is a living, hard and strong structure which cannot be compressed and bent. it is surrounded by a membrane known as periosteum.

Composition of Bone :- Bones of adults man contain – 65% inorganic matter (i.e- calcium phosphate, carbonate) and 35% organic substance (i.e- protein, collagen).

Structure of Bone :-

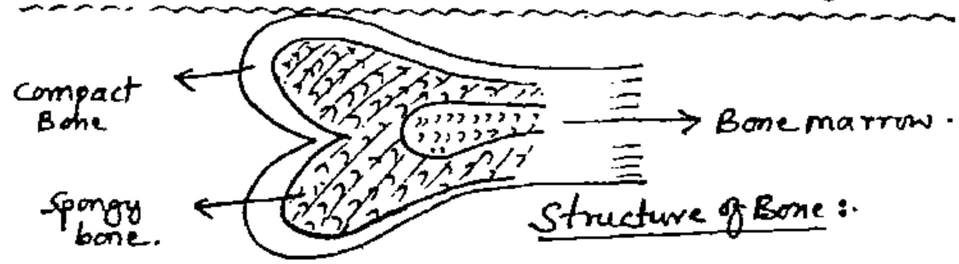
1- **compact bone :-** The hard, white outer layer of the bone is called compact bone.

2- **matrix :-** The bone matrix contains collagen fibres. The matrix is also saturated with calcium phosphate. It gives strength to the bone.

3- **Osteocytes :-** within the bone matrix, bone cells called osteocytes are present in spaces called Lacunae. The bone matrix contains nerve fibres and blood vessels, which keep the osteocytes alive.

4- **Spongy bone :-** Beneath the compact bone the Spongy bone is present.

5- **Bone marrow :-** The space within Spongy bone contain bone marrow, where most blood cells are formed.



Structure of Bone :

Functions of Bones :-

1- muscles pull our bones to enable movement.

2- Bone give shape and structure to the body.

3- It provides Support and protect delicate internal organs. eg- heart, Lungs, etc.

4- Internal portion of many bones produces red Blood cells, platelets, and white blood cells.

5- Bones also stores minerals.

②- Cartilage :

Introduction :- cartilage is a softer types of connective tissue, consists of tough, elastic, homogenous materials.

Covers various parts :- cartilage covers ends of the bone at the joint, and also supports the flexible portion of nose and external ears.

Composition of cartilage :- cartilage mostly contain organic substances and may may not have calcium salts.

Structure of cartilage :-

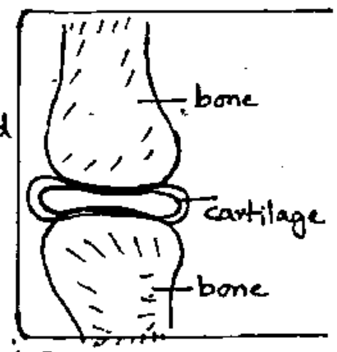
1- Ground substance :- it is the amarphous gel like substance present in extracellular spaces.

2- Collagen fibres :- The ground substance of cartilage

contains collagen fibres in parallel arrangements.

3- Chondrocytes:- The cell of cartilage called chrond-rocytes are also present in ground substance within Spaces called lacunae. The number of chrondrocytes found in cartilage determines how flexible or elastic the cartilage is.

4- Blood vessels :- There are no blood vessels present in the ground Substance of cartilage.



Types of cartilage :-

There are three types of cartilage. i.e-

①- Elastic cartilage :- In elastic cartilage the cells are closer together and there is less ground substance. Elastic cartilage is found in the external ear flaps and in Epiglottis.

②- Hyaline Cartilage :- Hyaline cartilage has less number of cells and more ground substance. Hyaline cartilage is found at the ends of the long bones, in the Nose, ears, Trachea, larynx, and bronchi.

③- Fibrous Cartilage :- fibrous Cartilage has the least number of cells, so it has maximum ground Substance

Fibrous cartilage is found in the inter-vertebral disc.

Q-4: What is joint? classify the types of joints and give specific example for each type.

Answer:- Joints:

Definition :- Any loose, flexible connection between two bones or between bone and cartilage is known as joints.

→ In vertebrates the bones of skeleton are of different types. The point where two bones meet together are called joints.

Functions of joints :-

1- They keep our bones together by holding them with each other.

2- They also allow the bones to move to different extents and give mobility to our body.

Types of joints :- Joints are classified into three categories on the basis of extent of movement. i.e-

①- Immovable joint :-

Definition :- Those joints where movement of bones donot occur relative to each other is known as Immovable joints.
→ it help in protection of body parts.

Examples :- 1- Joint between the bones of cranium.

2- Joints between the bones of face.

3- The attachment of teeth in the sockets of jaw. etc.

②- partially movable joint:

Definition :- Those movable joints in which movement of bones occur with in a limited range ared partially or slightly movable joint.

Examples :- 1- joints between the Vertebrae of vetebral column.
2- joints between the Sacrum and hip bones.

③- Freely moveable joint:

Definition :- Those joints where movement of bones occur relative to each other is known as free moveable joints.

Types :- Free movable joints are further classified into the following two groups.

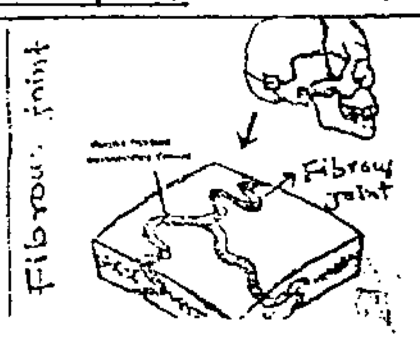
ⓐ- Hing joint :- Those joints where bones allow movement in two directions only are know as hinge joint.

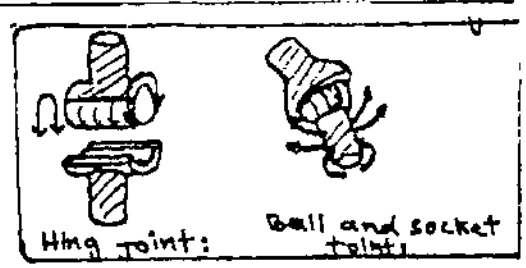
Example :- 1- Elbow joint. 2- Knee joint
3- joint between the phalanges of fingers or toes, etc.

ⓑ- Ball and Socket joint:

Those joints where bone allow movement in all directions are known as ball and socket joint.

Example :- 1- Shoulder joint. 2- Hip joints.





(Q-5:) what are ligaments and tendons? what function do they perform.

Answer:- ①-Ligaments:-

Definition:- The type of connective tissue that hold bone with each other at joint are called ligaments.

→ They are flexible and in the form of bands.

Function:-

It gives strength to joints and help in movement.

②-Tendons:-

Definition:- The rope like end of the muscle attached with the bones is called tendons.

→ Tendons are tough connective tissues, which attach muscles to bones.

Function:- when a muscle a muscle contracts, tendon exerts a pulling force on the attached bone. As a result the bone is pulled towards the muscle.

(Q-6:) what is the contribution of Vesalius in understanding the human Skeleton?

Answer:- Vesalius:- Vesalius was born in

Brussels (Belgium) in 1514 and died in 1564. Visalius Completed his medical training in France. Latter on he became a professor of anatomy at padua university.. .. in Italy.

Contributions :-

1- He gave the Idea that human body can be dissected which was not allowed at that time.

2- For this purpose, he collected bones from grave and even stealing dead bodies from gallows to explore human anatomy.

3- He wrote a book in 1543 called "De Humani Corporis Fabrica."

4- This book was based on direct observation of the human internal organs.

5- This book had 277-diagrams showing human anatomy by famous artist Titian.

6- He illustrated medical text, where the drawing showed the human body in greater detail than even before.

7- He explain the different parts of the human skeleton, including the number of bones.

8- He also described the source and position of each muscle and provided information on their respective functions.

(Q-7:) What are Muscles ? write its different types.

Answer: Muscles:

Definition :- Muscles are the bundles of cells or fibres

that can be contracted and expanded to produce physical movement.

(The human body has over 500-muscles responsible for types of movement.)

→ The study of muscles is called myology.

Types of muscles :- There are 3-types of muscles. i.e—

①- Skeleton muscle :

Muscles that are attached to the skeleton and associated with the movement of bones are called skeleton muscles.

Characteristics :

1- The skeleton muscle cell shape is spindle or cy..drical.

2- they are also called striped or striated muscle because they show alternate light and dark bands.

3- They are consciously controlled and therefore are called voluntary muscles.

4- Their working is fast but they fatigue easily.

Example :- muscle of arms and legs.

②- Smooth muscle :- Smooth muscles are the earlist evolved muscles, present throughout the animal Kingdom.

Characteristics :-

1- The smooth muscle cells are long and spindle shaped.

2- They are also called non-striated or unstriped muscles because they have no light and dark bands.

3- The contraction of smooth muscle is involuntary.

4- They can not fatigue easily.

Example :- smooth muscles are present in blood—

vessels, digestive tract and urinary bladder.

③- Cardiac muscle :- cardiac muscles occur only in the heart where they constitute the bulk of the heart walls.

Characteristics :-

1- Heart muscle is composed of chains of single cell. The cells are branched, interconnected and organized into fibres

2- The cardiac muscle are also called striated or striped muscles because they show alternate light and dark bands.

3- They are spontaneous and involuntary.

4- They contact and relax rhythemitically without getting any fatigue.

Example :- These are muscles of the heart. they constitute most of the mass of the heart walls.

(Q-8:) What is antagonism? Relate any pair of muscles in your body to antagonist movement.

Answer: Antagonistic muscle :

Introduction :- most muscles of our body work in pair in such a way that when one muscle contracts the other relaxes or vice versa. This type of muscle arrangement is called antagonism and the muscles acting in this way are called antagonistic muscles.

Explanation :-

Antagonistic muscles work in pair. one muscle is called

flexor and the other is called extensor. i.e—

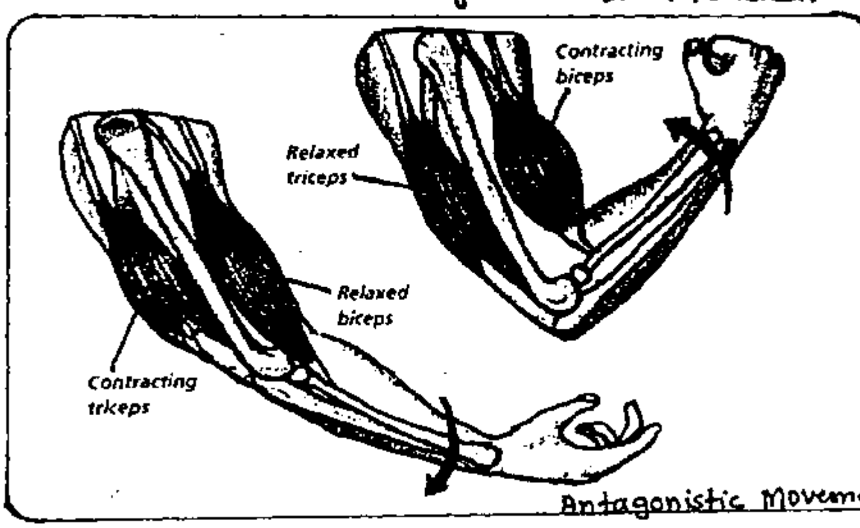
①- Flexor :- It is the muscle which bends or flexes a limb (arm, leg) when contracts, is called a flexor.

e.g— Biceps of our upper arm.

②- Extensor :- It is the muscle which extend or staighten a limb when contracts.

e.g— Triceps of our upper arm.

For example : → when the biceps of our upper arm contracts, the triceps relaxes and the arm is bent or flexed. → when the triceps contracts, the biceps relaxes and the arm is straightened or extended.



Antagonistic Movement.

(Q-9:) Describe the Osteoporosis.

Answer :- Osteoporosis : (osteo—Bone, poros—pore)-

Definition :- The disorder of bones in which the bones

become thin, soft, reduces in mass, start bending and can easily be broken.

Causes :- 1- It is mainly caused in adult age due to deficiency of calcium in their body.

2- Deficiency of estrogen hormone in aged women.

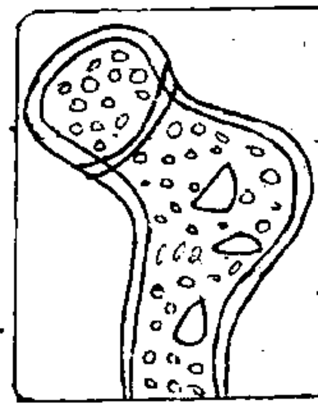
3- insufficient exercise.

4- Demineralization is the process in which calcium moves from the bones to the blood in order to maintain its level.

Symptoms :- 1- severe pain in the back region and fracture from minor fall.

2- Bending of weaker bones.

3- compression in the back bone and inter-vertebral disc.



Bone with osteoporosis

Prevention :

1- Taking balanced diet which is rich in calcium and phosphate. & 2- Regular exercise.

(Q-10:) what is Arthritis ? Discuss its types.

Answer :- Arthritis :

Definition :- Arthritis is inflammation of one or more joints.

Causes :- Arthritis may be due to viral infection, injury, old age or deposition of calcium at joint.

Symptoms :- 1- Joint pain and swelling.

2- Stiffness particularly in the morning.

3- Inability to move the joint easily.

Treatment :- 1- Arthritis can be treated by using pain killer and anti-inflammatory medicines.

2- physical therapy (Exercise) can improve range of motion and strengthen the muscles surrounding joints.

3- Arthoplasty surgery can also be performed in which the affected joint is replaced with an artificial joint.

Types of Arthritis :-

①- Osteoarthritis :- The common type of joint disorder in which cartilage is affected and started to wear away over time.

Causes :- 1- It is due to degeneration in the cartilage present at joint. ②- Decreased lubricant production at joint.

Symptoms :- Osteoarthritis cause joint pain and can limit a person normal range of motion when the disorder is sever the joint may loss all movement causing a person to become disable.

Treatment :- 1- It can be treated by using pain killer and anti-inflammatory medicines.

2- physical therapy (Exercises) can improve range of motion and strengthen the muscles surrounding joints.

3- Arthoplasty surgery can also be performed in which the affected joint is replaced with an artificial joint.

2- Rheumatoid arthritis :-

This is an auto-immune disease in which the body immune system attacks, healthy joints.

For example :- It usually affects joints in the fingers, wrists, knee, and elbows.

Symptoms :- It causes pain, stiffness, swelling and loss of function in joint. In severe case it deforms or changes ..a joint.

Treatment :- 1- It can be treated by using medicine or physiotherapy (Exercises). 2- Arthoplasty surgery.

3- Gout Arthritis :

The type of joint disorder in which the deposition of uric-acid crystal occurs in joints is called Gouty arthritis.

Causes :- It is caused due to increased uric-acid level in blood. This condition is called hyper-Urema.

Symptoms :- In this disease the joint become red hot and swelled.

For example :- It usually affects the joint at the base of big toe. other joints (e.g- Knees, wrists, and Fingers) may also be affected.

Treatment :- 1- It is treated by taking steroid, 2- physiotherapy. 3- by reducing body weight. 4- Arthoplastic surgery.

Exercise

(Q-A:) Select the best suitable answer

(1)- which of these is a part of appendicular skeleton?

(a)- ribs (b)- Sternum ✓(c)- pectoral girdle (d)- V-column

(2)- The joints between skull bones are an example of

(a)- Ball and socket joint (b)- Hinge joints.

✓(c)- immovable joints (d)- slightly moveable joints.

(3)- which type of joint is present b/w the vertebrae.

(a)- Fixed joint ✓(b)- slightly moveable joint.

(c)- Ball and Socket joint (d)- Hinge joint.

(4)- which of the following is not part of the axial skeleton.

(a)- sternum (b)- vertebrae ✓(c)- leg bones (d)- skull.

(5)- Bones are stronger than cartilage due to the presence of

(a)- collage fibres (b)- Osteocytes ✓(c) calcium phosphate (d)- lacuna

(6)- The main protein in the matrix of cartilage is

✓(a)- collagen (b)- Osteonectin (c)- Keratin (d)- Actin.

(7)- which connective tissue attaches two bones at a joint.

✓(a)- ligament (b) Tendon (c)- cartilage (d)- marrow.

(8)- In which disease, the bone become weak and brittle?.

(a)-Osteoporosis (b)-Osteoarthritis

(c)-Rheumatoid arthritis (d)-Vertebral column.

(9)- The point where the muscle attaches to the fixed bone is called-

(a)-Tendon (b) Ligament (c)-Insertion (d) origin

(10)- Arthritis is defined as inflammation in

(a)- Bones (b) joints (c)- cartilage (d)-muscles.

(Q-B:) write Short answers to the following questions.

(1)- why are bones considered as dynamic structures?

Answer: Bones as dynamic structures:

Introduction:- Bones are dynamic in the Sense that they are constantly being broken down and built back up.

For example :-

→when calcium levels in blood are low, cells called osteoclasts break down bone martix and release the calcium into the blood. →when blood calcium levels are high, cells called osteoblasts take calcium out of the blood and use it the built bone martix.

(2)- what is the contribution of vesalius in understanding the Human skeleton.? **Answer:** See Q.No. 6, at page No - 118-119

③ - Describe the function of three major types of joints and give an example of each.

Answer: Functions of joints:

1- Functions of Immovable joints :-

→ These joints provide strength and support to the body.

→ These joints have protective role becuse they protect sensitive body organs.

Example :- The bones of skull, between the bones of pelvic girdle, between sacrum and iliac bones.

2- Function of slightly movable joints :-

→ these joints allow slight movement between the two bones because cartilage of these joints form a flexible connection.

Example :- present between — vertebrates, wrist, ankles bones, &

3- Functions of movable joints :-

→ These joints allow the movements in two or several directions.

Example :- joints of knee, lower jaw, hips and shoulder.

④ - How are different types of arthritis caused?

Answer :- See question No — 10, at page No — 124, (only types)

(5)Q- Differentiate between a skeletal muscle's origin and insertion.

Answer :- 1- origin point :-

Definition :- The end of the muscle attached to immovable bones is called origin point.

Example :- Attachment of skeleton muscle with Scapula.

2- Insertion point :-

Definition :- The ends of the muscle attached to movable bones are called insertion point.

Example :- Attachment of muscle with radius.

(6)Q- State the functions of flexors and extensors.

Answer :- See Explanation and Examples of Question No-8, at page No- 121-122.

(7)Q- What are ligaments and tendons? What function do they perform?

Answer :- See question No-5, at page-118

(8)Q- State five functions of bones.?

Answer :- See question No-3 (only functions), at p-114

(Q-C) write detailed answers to the following questions

(1)- Describe the role of skeleton and muscles in locomotion.

Answer.

1- Role of Skeleton in locomotion:-

Due to joints, skeleton allow the bones to move to different extents and give mobility to our body.

2- Role of muscles in locomotion:-

muscular system has an important role in movement. Skeletal muscles are attached to the bones. Due to the attachment of muscles with the bones, these bones move and thus we can move.

(2)- Differentiate between the axial and appendicular skeleton and describe the major components of both.

Answer:- See question No-1, at page- 107

(3)- Discuss different types of joints and their role.

Answer:- See question No-4, at page No- 116.

(4)- write the causes and treatments of arthritis and osteoporosis.

Answer:- See question No-(9) and (10), only causes and treatment, at page No- 123, 124.

Inheritance

Unit-15

(Q-1:) Differentiate between Genetics, Inheritanc and Variation.

Answer :- ①- Genetics :-

"The branch of biology which deals with the study of inheritance and variation is called genetics."

History of Genetics :-

The word genetics was 1st time used by "W. Betensin" in 1906. where as "G. Mendel" discovered fundamental mechanism of inheritance and was thus considered as "Father of Genetics".

②- Inheritance : ⟨Heredity⟩

"It is the process by which characters are transmitted from parents to offsprings."

→ DNA is responsible for this transmission.

③- Variation :-

"Differences among the offsprings are called variation." → We see in our daily life that no two individuals of a species are not exactly similar even the twins. This difference may be in height, skin, colour or intelligence. it is callec variation.

Q-2: write a detail note on chromosomes.

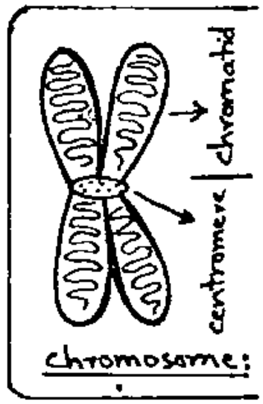
Answer: chromosomes:

Meaning:- "chromo" means coloured and "soma"-body.

Definition:- "chromosomes are thread like, colour structures, produced from chromatin-material, appears inside the nucleus at the time of cell division."

Discovery:-

chromosomes were first observed by German embryologist "W-fleming in 1876. In 1908 sutton identified the function of chromosomes, that they take part in the transportation of hereditary characters.



Location:- → In prokaryotic cells chromosomes are not enclosed by the nuclear-membrane and are present in the cytoplasm.

→ while in the Eukaryotic cells they are enclosed by the nuclear-membrane and are present inside the nucleus.

Chemical Composition:- In prokaryotes the chromosomes consists entirely of DNA, while in Eukaryotes the chromosomes consists of DNA and proteins.

Number :- In Eukaryotic cells the number of chromosomes is specific and remain constant. For example human has 46-chromosome in each somatic cell, potato has 48 and fruit-fly has 8-chromosomes.

Structure :- Each chromosome consist of two part

1)- **Chromatids :-** Each chromosome is made up of arms called chromatids.

2)- **Centromere :-** chromatids are attached to each other by central joint called centromere.

(Q-3:) what is chromatin material, Explain it structure. OR

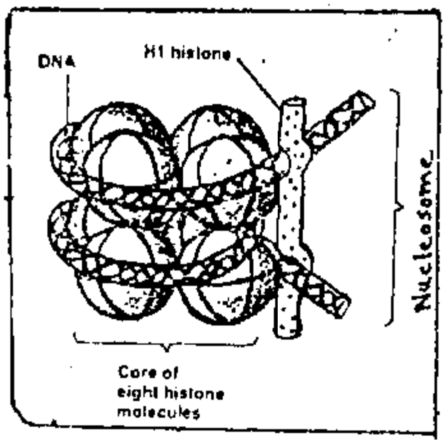
How are DNA and proteins packed to form a chromatin?

Answer :- Chromatin material :

Introduction :- The complex combination of DNA and histone protein is called chromatin, so chromosomes are composed of thread like structure called chromatin materials. chromatin further composed of nucleosome which is the unit of chromosomes.

Structure :-

1)- Nucleosomes :-



Nucleosome is the structural and functional unit of chromatin. Each nucleosome is composed of eight molecule of histone-protein, forming an octamere. Around the histone protein, two turns of DNA of 200-nucleotides are wrapped (لپٹے ہوئے).

2)- Nucleosome string :- The Nucleosomes are linked together like beads on a string.

3)- chromatine fiber :- Immediately the nucleosome string begins to coil again about its axis to form another thick fiber called chromatine fiber.

4)- chromatid :- when cell division begins, the higher order coiling of chromatin fiber gives rise to Supercoil form chromatid.

5)- chromosomes :- chromatids Combine with each other through centromere form chromosome.

Q-4: Differentiate between gene and Allele.

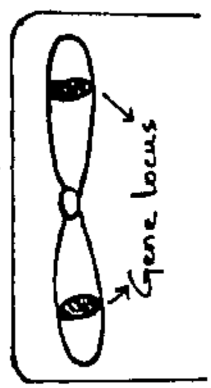
Answer: ①- Gene :-

Definition :- " A segment of DNA, consisting of specific nucleotides sequence that has code for protein synthesis is called gene."

Explanation :- Genes are located on chromosomes and they are responsible for the transmission of characters from parents to offsprings. The transfer of genes to the next generation take place through gametes.

Location :-

The position of a gene on the chromosome is called its locus. Genes work in pair i.e.— for a trait generally two genes are present on the chromosome having the same locus.



For example :- The gene controlling height in pea plant exist in two forms. One allele results in the tallness while other cause dwarfness.

②- Allele :-

Definition :- "Alternate form of the same gene is called allele." -(OR)-

"gene exist in pairs, each members of pair is called allele."

Location :- Alleles are located on the same locus on homologous chromosomes but they have difference in their nitrogen base sequence in the DNA.

Genotype :- The combination of the alleles of a gene pair is called Genotype.

Types of Genotype :- Genotype may be—

① **Homozygous :-** when a gene pair has the same alleles the genotype is called Homozygous.

② **Heterozygous :-** The genotype, in which gene pair has different alleles, is called Heterozygous.

For example :-

1- if a pea plant is tall and having "TT" alleles combination, so such same alleles combination for tall character is called Homozygous.

2- If a pea plant is tall and having "Tt" alleles combination So such alleles combination for tall character is called Heterozygous.

(Q-5:) different between dominant and Recessive alleles.

Answer: ① Dominant Alleles :-

The allele which control the working of the other allel in the heterozygous genotype is called dominant alleles.

②- Recessive Alleles :-

The allele which cannot Express in heterozygous condition is called recessive Alleles.

③- phenotype :- The character of a living organism which is visible is called phenotype.

④- Genotype :- The genetic make up of the character is called Genotype.

Symbols used for Alleles :- In classical method of symboling, dominant allele is represented by capital letter while recessive allele is represented by small letter.

For example :- for Tallness used "TT" and dwarfness "tt".

(Q-6:) Describe the role of gene in protein synthesis.

-OR-

Explain with the help of a diagram the relationship among DNA, RNA, and protein.

Answer :- **Role of gene in protein synthesis:**

protein synthesis is a two part process which take place with the help of DNA and RNA. It complete in two major steps. i.e—

①- Transcription :-

Definition :- "The formation of messenger RNA from DNA is called transcription."

Mechanism :-

→ In this process the two strand of DNA separate from each other and each strand then act as template for new complementry strand.

→ when mRNA is synthesize, it comes out by nuclear pore to cytoplasm carrying information for protein in the form of codons.

②- Translation :-

Definition :- "The process of protein synthesis is Known as translation."

Mechanism :- when messenger RNA is formed, it moves from nucleus to cytoplasm through nuclear pores and attaches to ribosomes.

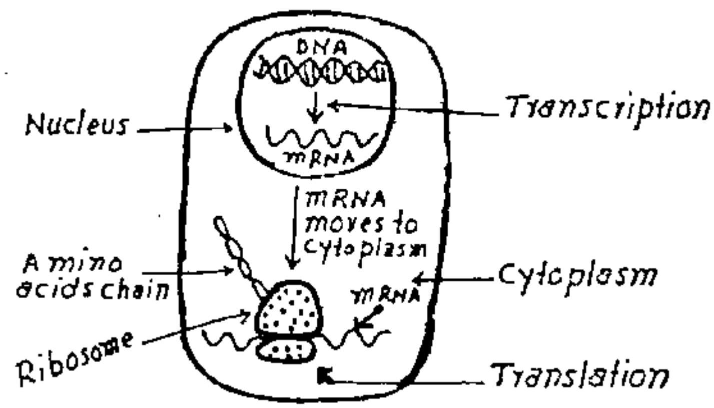
In protein synthesis three types of RNA play important role i.e—

a)- **mRNA :-** It carries information from DNA to ribosomes for protein synthesis.

b)- **rRNA :-** It is present on ribosomes, which

recognizes (reads) the message of mRNA for protein synthesis.

c)- tRNA :- It picks up amino-acids in cytoplasm and transfers them to ribosomes for protein-synthesis, where they are linked to each other to form proteins.



Summary of protein synthesis

(Q-7:) Write a note on the history of Mendel?

Answer :- History of Mendel :

G. Mendel was belonging to a peasant family. Mendel lived from 1822 to 1884. He was an Austrain monk. He performed his famous experiments on the garden pea in the 1856–1864. He examined the inheritance patterns in pea and led him to the discovery of several

principles of inheritance. For his valuable work in genetics, Mendel is regarded as the "Father of genetics."

(Q-8:) Why Mendel selected garden pea plant for his experiment.

Answer:- Choice of Mendel Experimental material:-

The main reasons for the selection of pea-plants were as follows—

1- Easy to cultivate.
2- Flowers are hermaphrodite.
3- It is normally a self fertilizing but cross fertilization can be made.
4- Time gap between the generations raising is short.
5- pea plant has very sharply distinct traits with two clear cut alternate and contrasting pair forms or alleles.
6- Numerous Varieties are available.
7- These plants produced a large number of seeds.
8- They have prominent inherited characteristics.

(Q-9:) Discuss the seven characters studied by Mendel in pea plant.

Answer: Seven character in pea plant:

Mendel Studied seven different characters in pea plant. Those characters which appear in the offsprings of F_1-generation are called dominant, while those characters which do not appear in the offsprings of F_1-generation are called the recessive characters.

The F_1-offspring that result from two parents with different characteristic are called Hybrids.

The following chart clearly shows the dominant and recessive characters, i.e —

	Characters	Dominant	Recessive
1	Seed shape	Round	Wrinkled
2	Seed colour	Yellow	Green
3	Flower Colour	Violet	White
4	Pod shape	Full	Constricted
5	Pod colour	Green	Yellow
6	Flower Position	Axial	Terminal
7	Stem height	Tall	Dwarf

Seven Characters in Pea Studied by Mendel

(Q-10:) Explain Mendel's law of segregation (monohybrid cross) by giving a suitable example.

Answer: Law of Segregation: (Monohybrid cross):

Definition :-

"This law states that each diploid organism possess

two alleles of a give gene, which segregate at the time of gametes formation," and each gamete receives one or the other allele, but not both. -OR-

"The cross between two parents which differ only in one character is called monohybrid cross."

Explanation with example :-

1- Mendel crossed true breeding tall pea plant with true breeding dwarf (short) pea plant. He called this parental generation denoted by "P."

2- All the offsprings obtained in the next generation were tall. He called this First filial generation denoted by "F_1".

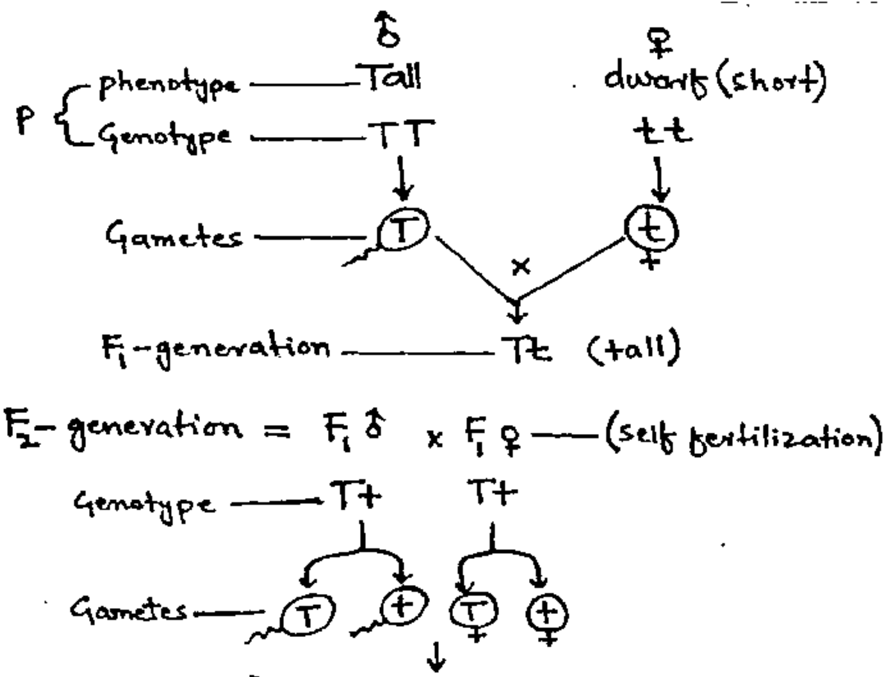
3- In F_1-generation the gene of the tall plant express itself and was called 'dominant', while the gene of short plant could not express itself and was called 'recessive'.

4- Now, the F_1- plants were self-fertilized and second Filial generation (F_2) was produced.

5- In F_2-generation some plants were tall like the original tall parent and some were short like the original short parent plant in the ratio of 3:1.

Graphic presentation of Monohybride cross :-

If Tall plants respresented by "TT" and short by "tt" then the cross can be shown as ——



checker board:

♀ \ ♂	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt short

Summary chart (F_2):

phenotypic ratio = 3-tall : 1-short [75% : 25%]

Genotypic ratio = 1-pure tall (TT) : 2-hybrid tall (2Tt) : 1-pure short (tt)

(Q-11:) Explain Mendel law of independent Assortment by giving a suitable example.

Answer :- Law of independent Assortment: (Dihybrid cross):

Definition :- "This law states that when two

contrasting pairs of traits are brought together in the same cross, the distribution of alleles for one trait in the gametes does not effect the distribution of the alleles for the other trait." -OR-

"The cross between two parents which differ in two characters is called dihybrid cross."

Explanation with Example:

1- Mendel crossed true breeding round-yellow seeded plants with true breeding wrinkled-green seeded plants. He called this parental generation denoted by "P."

2- All the plant of the next generation produce seeds which were round and yellow. He called this first filial-generation denoted by "F_1".

3- In F_1-generation the gene of round and yellow traits express itself and were called dominant, while the genes of wrinkled and green traits could not express itself and were called recessive.

4- Now the F_1-plants were self-fertilized and a second filial generation (F_2) was produced.

5- In F_2-generation the plants were of four types i.e— Round yellow, Round green, wrinkled yellow, and wrinkled green in the ratio of 9:3:3:1.

Graphic presentation of dihybrid cross:

If "R, Y, r, y" respresents "round, yellow, wrinkled and green" respectively, then the cross can be shown as—

	♂	♀
P: phenotype	Round-yellow	wrinkled-green
P: Genotype	RRYY	rryy
Gametes	(RY)	(ry)

F₁-generation —— RrYy (round-yellow)

F₂-generation = F₁ ♂ × F₁ ♀ —— (self-fertilization)

Genotype —— RrYy RrYy

Gametes —— ♂: (RY) (Ry) (rY) (ry) ♀: (RY) (Ry) (rY) (ry)

checker borad:

♀ \ ♂	RY	Ry	rY	ry
RY	RRYY Round-yellow	RRYy Round-yellow	RrYY round-yellow	RrYy round-yellow
Ry	RRYy Round-yellow	RRyy round-green	RrYy round-yellow	Rryy round-green
rY	RrYY round-yellow	RrYy Round-yellow	rrYY wrinkled-yellow	rrYy wrinkled-yellow
ry	RrYy Round-yellow	Rryy Round-green	rrYy wrinkled-yellow	rryy wrinkled green.

Summary chart (F_2):

phenotypic ratio = 9-round-yellow : 3-round-green : 3-wrinkled yellow : 1-wrinkled-green.

Genotypic ratio = 4:2:2:2:2:1:1:1:1

(Q-12) Discuss different dominance relation.

Answer: Dominance Relation:-

introduction:- Dominance is a physicological effect of an allele over its partners allele on the same gene locus. Dominance relationships are the various ways in which we use see that how the two alleles at one gene locus can affect the phenotype in heterozygous state.

Types of dominance relation:

①- complete dominance:

Definition:- "Dominance in which one allele (i.e- dominant) completely hides the effect of other allele (i.e- recessive) is called complete dominance."

Example:-

The allele for tall character i.e "T" is completely dominant over the allele of short character i.e "t". So in the heterozygous condition i.e "Tt" the tall character is completely expressed and hides the short character.

②- Incomplete dominance:

Definition:- "Dominance in which one allele (i.e- dominant) cannot completely hide the effect of other allele (i.e- recessive) is called incomplete dominance."

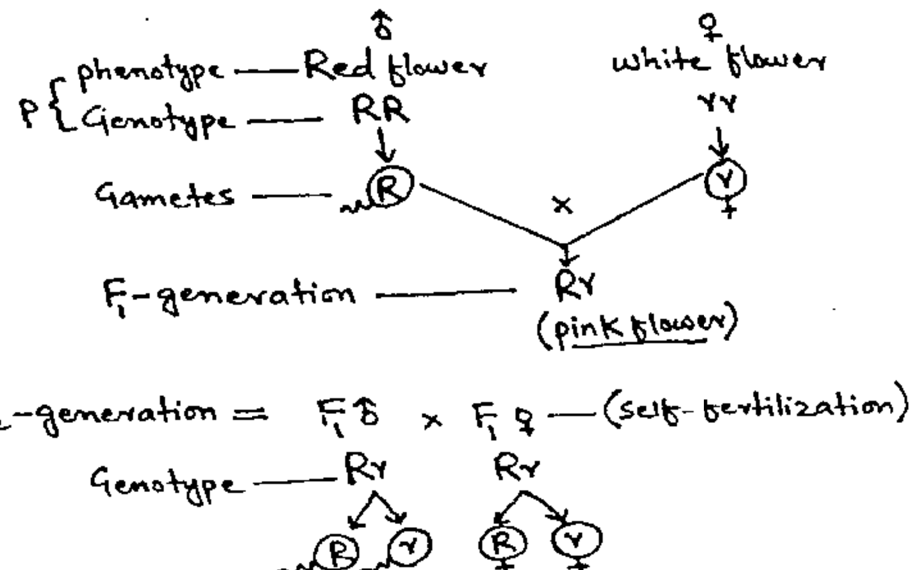
Example:- 1- Japanies Four O' clock plant (*Mirabilis Jalapa*) produces two types of

flowers, Red color (RR) and white color (rr).

2- Whenever a red color variety is crossed with white color variety, the F_1- offsprings will have pink colour, and pink is intermediate between Red and white colour.

3- When the F_1-plants were crossed with one another, the plants produced in the F_2-generation were — Red, pink and White in a ratio of 1:2:1.

Graphic presentation :-



Checker board:

♀ \ ♂	(R)	(r)
(R)	RR Red	Rr pink
(r)	Rr pink	rr white

Summary chart:

phenotypic ratio = 1-red flower : 2-pink-flower : 1-white flower

③- co-dominance:

Definition :- "The dominance in which the heterozyggous Individual clearly shows the effect of both alleles is called co-dominance."

Explanation :-

co-dominance occurs when both the alleles express independently in heterozygote. The co-dominant heterozygote would have both alleles which are equal express and produce mixed phenotype.

Example :

In case of blood group-"AB" both antigen-'A' and antigen-'B' are expressed and the group is named as blood group-AB. i.e—

P { Phenotype — Blood group-A (♂) Blood group-B (♀)
P { Genotype — I^AI^A I^BI^B

Gametes — I^A × I^B

F_1-generation — I^AI^B (AB-blood group)

(Q-13:) what is variation, write its sources and importance.

Answer: Variation :

Definition :- "Differences in traits between individuals of the species are called variation."

Explanation :- No two individuals are exactly

identical. They must possess some differences. These differences are called as variation, which is very necessary for natural selection. It means nature only select the best adapted variants.

Sources of variations:

Those factors which brought variations are called Sources of variations. i.e—

①- Genetic Recombination :-

The recombination or rejoining of assorted alleles are called recombination.

②- Independent Assortment :- During meiosis alleles segregate independently and are assorted during their inheritance to next generation. this is also one of the source of variation.

③- Crossing Over :- The exchange of segment between non-sister chromatids is called crossing over. crossing over is one of the important source of variation, which brings about differences in the next-generations.

④- Random fertilization :- Each gametes has a unique genetic composition. Due to random-fusion of gametes it will produce different variations in organism.

(5)- Mutation :- Any change in the structure of DNA is called mutation. Alleles arise by mutation. due to mutation variations occurs, so mutation is the base of variations.

(6)- Environment :- Environment play a very important role in variation because in nature those variants are allowed to exist which are the fittest. So environment has greatly affect the variants, in such away that environment select only best variants. so only adapted and selected variant can further produces their offsprings.

Importance of Variation :-

1- positive varivation help in new species adjacement with a new Environment, therefore increase the chance of Survival.

2- The accumulation of variations through large number of generation leads to evolution of new species.

(Q-14:) what is variation, write its types.

Answer: Variations:

Definition :- "Differences in traits of characteristics between individual of the species are called variation.

Types of variations :- There are two types of variation.

(1)- continuous variations:

Definition :- "The variations, which consists of a variety of intermediate phenotypes between the two extremes, are known as continuous variation."

Example :- In humans – heights, skin colour, weight and I.Q show continuous variation.

Genetic reason :- Such variations are controlled by many gene. These genes show additive effect for example more genes for tallness will result in a tall person.

Role of environment :- continuous variations are strongly affected by environment. For example good I.Q also needed proper eduction and training which is provided by the environment.

②- Discontinuous variations:

Definition :- "The variations which show distinct phenotypes and no intermediate characters are known as discontinuous variations."

Genetic reason :- These variations are caused by a few genes. For example Human blood groups are mainly controlled by three alleles i.e – I^A, I^B, and i. We have 4-types of blood groups i.e–"A, B, AB and O". There is no blood group having intermediate values.

Role of enviroment :- These variation are not modified by environment.

other example :-

1)- All seven characters studied by Mendel in peaplant.

2)- Gender in man. 3)- Ear lobes.

(Q-15:) what is Evolution, How variations Leeds to evolution, Explain ?

Answer: Evolution:

Definition :- "The gradual changes in living organisms over the course of generation through a long time that lead to the development of new species is called evolution."

Explanation :-

Variation is considered to be the base of evolution. where as evolution is a gradual change in characters of population over the course of generation through a long time is called as evolution. The process of evolution is very slow gradual and it occurs in population rather than individual.

Descent with modification implies that new types of organisms developed from ancestral with certain structure and features changes.

Variations and Natural selection Lead to Evolution.

For example :- Natural selection is the process through which the individuals with better characters (Variation) produce more Surving offsprings than the individuals lacking these Variations. As a result, the population gradually includes more individuals with better variations.

The beauty of the nature is because of the diversity among the living organisms

(Q-16) Explain Darwin's theory of Natural selection

Answer: Darwin's theory of Natural selection:

Introduction :-

According to this theory nature select the best variant which can only then further increase their offspring.

→ According to Darwin (1809–1882) evolution may occurs in the following way.

①- Overproduction :- organism has maximum potencey to increase their offspring. However resources in environment are very limited which creates competition for survival. So limited number of offspring survive due to competition.

②- Heritable variation :- The changes at gene level that pass from parents to offspring are called heritable variations. In nature those

individuals will survive that possess variations that best suit them to their environment, while the other will be perish.

③- Competition :- organisms compete with one another to get sufficient resources. So only those Individuals can survive which compete successfully. it mean nature select the best fitting individual.

④- Natural selection :

Nature selects those organisms who have best adapted with changing environment. It is known as nature selection.

⑤- Reproduction :- The best adapted individual survive and reproduce, which can pass best or favourable variation to their next generation.

⑥- Speciation :-

Due to continuous force of nature and evolution new species are form after long time. This is called speciation.

Eample of Natural Selection :- An example of natural selection is the evolution of pesticide resistance in insect species. pesticides are poisons used to kill pests (harmful insects). when a new types of pesticide is used, a relatively small amount may kill 99% of pests. But later spraying are

less and less effective. because adaptation against pesti develop in insects and inheritance to next generation, result such chemical now cannot killed the pests.

(Q-17:) How Arificial Selection helps in crop improvement.

Answer: Arificial Selection: <selective breeding>

Definition :-

"The process by which numerous breeds of plants and animals have been produced by man is called artificial selection.

Explanation :- It is an old method in which we interbreed those organisms which have our desired characters to obtain offsprings having these characters in combined form. It is also called Hybridization and the organisms produced by this method are called Hybrid-organisms.

Crop improvement :-

① By means of selective breeding we have improved our crops such as - wheat, maize, rice, vegetables and fruits.

②- All present-day crops have been extensively reshaped from their wild ancestors by the repeated application of artificial selection. For example, the major cereals (rice, wheat, maize) were all developed from wild grasses by artificial selection

between 7000 and 12000-year ago.

③- many plant varieties (cultivers) have been produced for better quantity and quality of food in plants like-wheat, rice, potato and Apple, etc.

④- many ornamental plants breeds are the result of selection.

Animal improvement : ①-We have obtained new varieties of dogs, cats, rabbits, Fishes, cows, buffalloes and horses by hybridization.

②- many breeds of sheep, goat, cow, hen, etc have been produced by artificial selection to increase the production of meat, milk, eggs, wool, etc

-End-

Genotype	Relationship between alleles	Antigen produced	Phenotype
I^AI^A or I^Ai	Allele I^A is dominant over i	A	Blood Group A
I^BI^B or I^Bi	Allele I^B is dominant over i	B	Blood Group B
ii	Allele i is recessive	No Antigen	Blood Group O
I^AI^B	Allele I^A and I^B are co-dominant	A and B	Blood Group AB

ABO blood group -

Exercise

(Q-A:) Select the correct answer:

(1)- Genes are short segments of

(a)- proteins (b)- carbohydrates (c) DNA (d)-lipids

(2)- The various form of a gene responsible for the same trait are called?

(a)- centromere (b)-character (c)- Trait (d)- Allele.

(3)- Natural selection operates to produce changes in

(a) individuals (b)-populations (c)-Races (d)- phyla

(4)- How many different types of gametes will be produced by a plant having a genotype AaBb ?

(a) Three (b)- Four (c)- Six (d)-Eight.

(5)- Speciation is the evolutionary process by which.

(a)- A new gene pool is formed (b)-Evolutionary path of a Spp coverage

(c)- Hybrid species is formed (d)-Shows differences in physical traits.

(6)- phenotype is the expression of.

(a) Genetic make (b) physical make up

(c)- Chemical composition (d)- metabolism.

(7)- The round structure formed when DNA coils around the histone protein.

(a)-centromere (b)-chiasma (c)- Nucleosome (d)-chromatin.

(8)- An allele which completely masks the effect of other allele in a heterozygous.

(a)- Dominant (b)- Recessive (c) co-dominant (d)- Incomplete dominant

(9)- The central dogma is best represented by-

(a)- DNA+RNA = protein (b)- DNA→RNA + protein

(c)- DNA→RNA→protein (d)- protein→RNA→DNA.

(10)- Type of dominance pattern followed by I^A and I^B alleles of human blood group system.

(a)- Homozygous dominance (b)- co-dominance.

(c)- Incomplete dominance (d)- None of the above.

(11)- what are the possible genotypes of a parents of Homozygous recessive individual?

(a)- Homozygous dominant (b)- Homozygous Recessive.

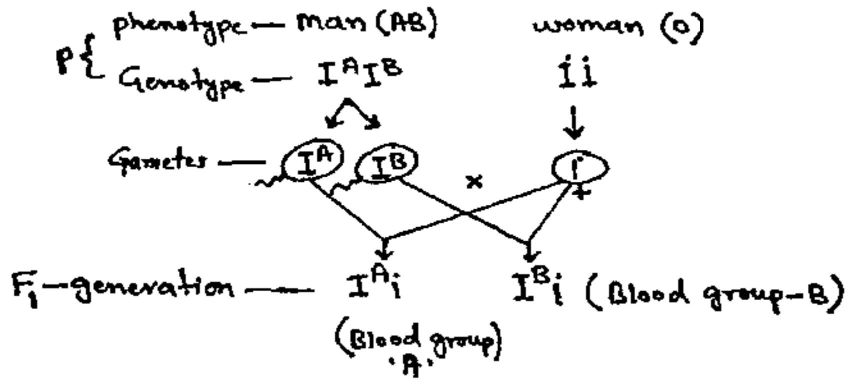
(c)- Heterozygous (d)- Both B and C

(Q-B:) write short answers to the following questions.

(1)- If a man with type AB-blood group marries a woman with type-O-blood group. what would blood types you expect in children/offspring.

Answer :- A man with Blood group-'AB' when marries with 'O'-blood group woman. Their childrens will

be having the following possible blood groups.



So their childrens will have— "A or B"— Blood groups.

②- How can crossing over bring variations.

Answer :- See question No – 13 (only part-2), at page-187

③- How are DNA and proteins packed to form a chromosome?

Answer :- See question No-3, at page No – 171

④- How is artificial selection used for the improvement of crops.

Answer :- See question No-17, at page No – 193

⑤- Differentiate between different types of dominant relations.

Answer :- See question No-12, at page No – 184

(Q-C:) write detailed answers to the following questions.

①- Relate the structure of chromosome with DNA and gene.

Draw a concept chart to explain your Answer.

Answer:- 1- Chromosome :- chromosomes are longer,

Sometime microscopically visible, structures in cells made of DNA and a few protein (Histone). chromosomes also contain genes in specific region called locus.

2- DNA :-

DNA is a double stranded nucleic-acid, contain different nucleotides. DNA is the physical molecule that makes up both chromosome and gene. DNA is typically found as one of the major parts of chromosomes. DNA is really long molecule, need efficient way to store. this is achieved by wounding the around the Histone protein to form a beads called Nucleosome, which further tightly wound to form the chromatids and than chromosome.

3- Gene :- Gene are much smaller Sections of the DNA (Specific nucleotide sequence of DNA) that specifically code for how to make protein or RNA needed by the cell. → So it is now clear that — "Gene is made of Specific nucleotides sequence of DNA and DNA combine with protein form chromosome.

Q- Explain with the help of a diagram the relationship among DNA, RNA and protein.

Answer :- See question No-6, at page No-175

③- Explain why Mendel selected peas as a subject for studying Genetics?

Answer:- See question No-8, at page No- 178

④- Explain law of independent assortment with the help of an example and chart.

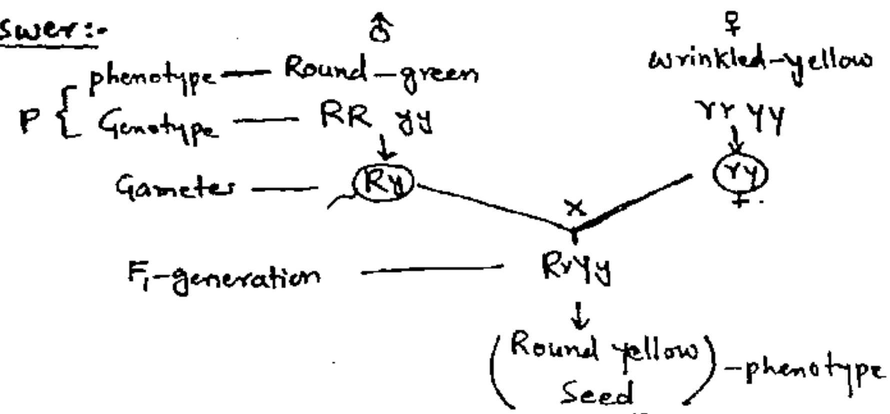
Answer:- See question No-11, at page No-181

⑤- Describe the sources of variations. Explain the importance of variations in organisms.

Answer:- See question No-13, at page No-186

⑥- Draw a cross between two pea plant. One of them has round green seeds (RRyy) while the other has wrinkled yellow seeds (rrYY)?

Answer:-



- End-

Biotechnology — Unit-17

(Q-1:) Define Biotechnology? Discuss its importance.

—OR—

what are the disciplines biotechnology deals with?

Answer :- Biotechnology :

Definition :- "The utilization of living organisms or their products for the welfare of human is called biotechnology."

Importance or disciplines of Biotechnology:

①- Medcines :-

→ with the help of biotechnology we are able to produce several antibiotic, vaccines, human hormones, vitamins and other medical product to treat diseases in plants, animals and human.

→ we can also treat many genetic disorders through genetic engineering.

②- Food and other industries :-

→ Fermentation is the back-bone of baking-industry, dairy-industry and wine-industry.

→ we are also obtaining acetone, spirite, and different organic-acids such as citric-acid on mass scale by fermentation.

(3)- Agriculture :- we have produced better varities of crops, fruits, and vegetable with greater yield.

(4)- Animal cloning :-

Scientists have successfully clonned — mice, sheep, cows and other animals through complex biotechnological procedures.

(5)- Disposal of wastes :- with the help of biotechnology we have find out many ways to dispose the wastes properly.

The science of fermentation is known as zymology.

(Q-2:) what is Fermentation? write its types.

Answer: Fermentation : <Anaerobic fermentation>

Definition :- "The incomplete oxidation of glucose into lactic-acid or Alcohol is called fermentation".

→ In this process a little amount of energy is released.

Types :- There are two types of fermentation i.e —

(1)- Alcoholic Fermentation : (By-yeast)

Definition :- "It is the type of fermentation in which Sugar is oxidized into ethyle-alcohol and CO_2 by yeast."

Mechanism :-

It is completed in two steps i.e —

1)- In the first step Glucose is broken down into pyruvate

2)- In the next step pyruvate is reduced into ethyle-alcohol and CO_2. i.e —

$$\text{Glucose} + 2\text{ATP} \longrightarrow \text{pyruvate} + 4\text{ATP}$$

$$\text{pyruvate} + NADH_2 \longrightarrow \text{Ethyle Alcohol} + CO_2$$

Importance :- Alcoholic-fermentation is used to produced different products such as – bread, beer, wine and distilled spirits.

②- Lactic-acid fermentation : (By Bacteria)

Definition :- "It is the type of fermentation in which sugar is oxidized into lactic-acid by Bacteria."

Mechanism :-

It is also completed in two steps. i.e –

1)- In the first step glucose is broken down into pyruvate

2)- In the next step pyruvate is reduced in Lactic-acid.

Glucose + 2ATP ⟶ pyruvate + 4ATP.

Pyruvate + $NADH_2$ ⟶ lactic-acid.

Importance :- In dairy Industry specific bacteria (e.g – Lactobacillus, etc.) are added to milk which convert milk sugar (lactose) into lactic-acid, which cause milk to curd and form yogurt.

(Lactic-acid fermentation also occurs in our skeleton muscle during exercise or hard job.)

(Q-3) Discuss the different products of fermentation.

Answer : Fermentation products :

Definition :- "Many substances can be produced by the process of fermentation, these are called fermentation products."

→ Some of the fermentation products are following –

(1)-Alcohol:- Alcohol is made as a result the fermentation of a natural sugar with a catalyst, which is usually yeast. During fermentation, the carbohydrates are the main Source which are converted into CO_2 and C_2H_5OH. Alcohol is widely used in medicines.

(2)-yogurt :-

"A thick semisolid soft form of fermented milk is called yogurt."

→ yogurt is produced by the process of fermentation. milk contain lactose which is converted to lactic-acid

(3)-Bread :-

Bread is actually carbohydrate containing fermentation product. In case of Bread, fermentation plays important role in raising of bread by producing CO_2 and is also responsible for its odour. This fermentation is mainly carried out by yeast and sometimes by bacteria.

(4)-cheese :- Cheese is formed when bacteria convert milk lactose into lactic-acid, due to which milk proteins are also coagulated. In this way, milk changes into cheese.

(5)-pickles :- pickles are made as a result of fermentation of fruits and vegetables. The by-products of fermentation turn fruits and vegetables into pickles.

⑥- Soy Sauce :- It is made by fermentation of soybeans by fungi.

⑦- chocolate :- It is produced when cacao beans undergo the process of fermentation.

⑧- chemical products :- many chemical products are also produced through fermentation. e.g - formic acid, glycerol, etc

(Q-4:) What is Fermenter? Explain the procedure to use a fermenter.

Answer : Fermenter :-

Introduction :- "A fermenter is a device which provide favorable environment for the growth of microorganism on commerical scale."

As we know that microorganism need three things - water, food and temperature. These substances are provided in a fermenter, for food products and commercial production of antibioties and hormones, etc.

products manufacture in Fermenter :-

Fermenters are used for the manufacture of many products For example - medicines, Enzymes, and chemical products.

procedure to use Fermenter :-

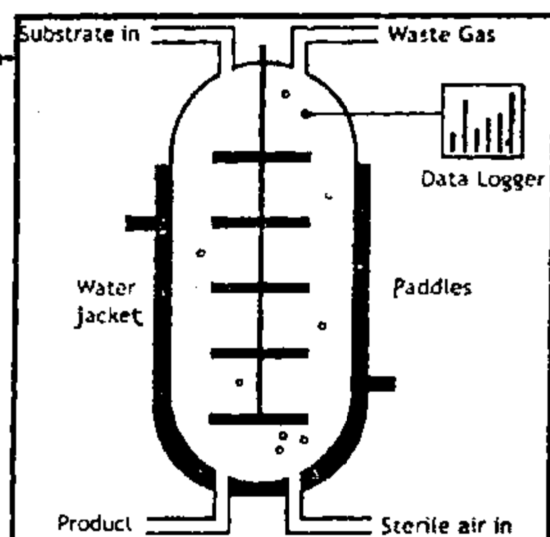
①- Discontinuous (Batch) fermentation :- in this fermen-tation, the tank of fermenter is filled with the raw

materials and nutrients. The population of microorganisms is added which performs fermentation and make products. During the reactions occuring in fermenter, no microorganisms or nutrients are added or removed from the culture. The contents of the fermenter are taken out for further processing after the required time has passed. The fermenter is cleaned and the process is repeated.

②- Continuous fermentation :-

In continuous fermentation, the exponential growth of microbes is maintained in the fermenter for prolonged peroid of time. while the population of microorganisms is added to the fermenter once, raw material and nutrients are added continuously at regular intervals.

Thus unlike batch fermentation, continuous fermentation process never stops in b/w and it continuous to run for a long peroid. The fermentation products are also taken out continously.



(Q-5:) What are the advantages of using fermenter

—OR—

How fermenter have made fermentation easy.

Answer: Advantages of fermenter:

Some advantages of fermenter are as under—

1. Fermenter is completely protected from environmental changes.
2. It has an autocontrol system.
3. Fermented products can be separated easily.
4. Microorganism culture can be easily introduce to fermenter.
5. wastage of products during handling is minimize through this apparatus.
6. single fermenter can be used for production of many products.
7. Fermenter can be installed in a very little space.
8. Fermenter also helps in the production of medical products, such as— pencillin, Insulin, Erythromycin, antifungal antibiotic, etc. from microb

(Q-6:) what is genetic engineering? write its objectives

Answer: Genetic Engineering:-

Definition:- "The Inserting of a gene from one organism to DNA of another organism for the

modification of its characteristics is called genetic engineering."

Explanation :- The DNA which is combination of genes from two different sources is called recombinant DNA. So this technology is also called recombinant DNA technology (rDNA-technology).

In 1970 it become possible to cut a piece from DNA and then can be transfer to host organism. Such organisms are known as Genetic modified organisms.

Objectives of genetic Engineering :

Following are the objectives of Genetic engineering

1. To identify and isolate a defective gene.
2. To treat genetic diseases, also called Gene therapy.
3. To find out treatment and therapy for non-genetic diseases of man, plants and animals.
4. production of genetically modified organism (GMO's)
5. Genetically modified crops and animals.
6. Improvement of quality of food.
7. preparation of Antibiotics, vaccines, polypeptides, Enzymes, insuline, synthetic hormones, etc.
8. Genetically modified crops and cattle produce more food in lesser time.

(Q-7:) Explain the basic techniques of genetic engineering?

Answer :- Basic technique of genetic engineering :-

Basic techniques of genetic engineering are—

Enzymes :- for cutting, Endonucleases enzymes used and for joining of two parts, Enzyme DNA-ligase used in this method.

①- Isolation of the gene of interest :- In the first step gene of interest is isolated and cut it into fragments of using restriction endonuclease, to cut the identified gene from the DNA of donor organism.

②- Insertion of the gene into a vector :

The gene which is isolated is now attach to a special replicon called as vector e.g.- plasmid is the vector, present in Bacteria.

③- Recombiant DNA formation :-

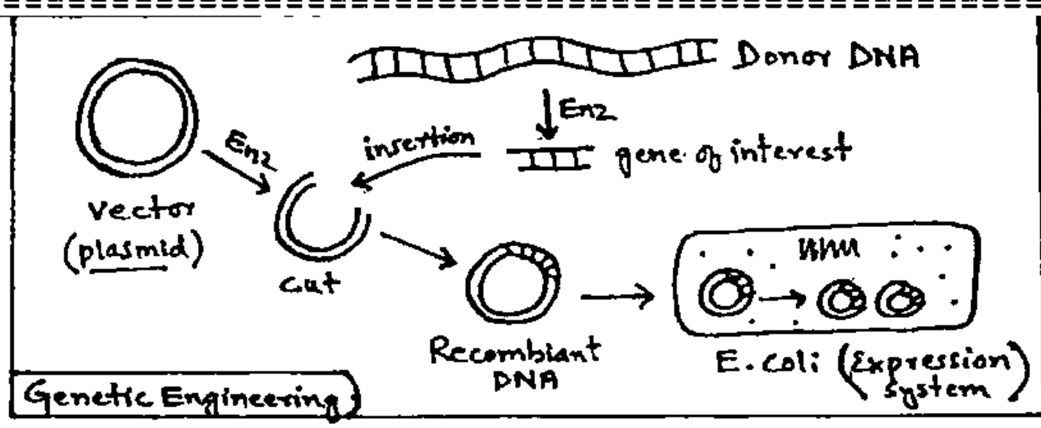
The DNA of vector is also cut by the same restriction enzyme. Now by using ligase the gene of interest and DNA of vector can be join. This process is called splicing and the DNA is now called rDNA.

④-Transfer of rDNA into the host :-

The rDNA is now introduce to host cell e.g.-E. coli. For this purpose the bacterial cells are treated with an enzyme. It digest some cell wall of bacteria and it become permeable for rDNA.

⑤- Expression of gene of interest : <Gene cloning>

within the host cell the foreign gene will ecode for that specific protein. For example insulin can be synthesize if gene for insulin was introduce in host cell. Besides this multiple copies of gene can be produce called as gene cloning in host bacterial cell.



Q-8: What are major achievement of genetic engineering in the field of agriculture.

Answer :- Achievement in the field of Agriculture :

Introduction :- Modern biotechnology has been considered as the second phase of green revolution.

→ Due to genetic engineering the following goal have been achieved.

i- Improved nutritional quality of food.

ii- Good nitrogen fixation in plants.

iii- Viral resistant plants.

iv- Herbicial resistant plants.

v- Insect and disease resistant plants.

vi- Drought tolerated plants.

→ Some of these Aspects are discussed as follow-

1- Resistance against Herbicides :-

Herbicides can Kill many types of weeds without harming crop. Those traits have been incorporated

into most varieties of soybean, corn and cotton. Some plants have naturally herbicide resistance, because resistance gene from those plants are taken and are incorporated.

2- Resistance against viruses :-

Plants can be tolerated against viral diseases. for this purpose a gene from virus which encode a protein in the virus outer coat is copied into the plant's genome. The plants then make the coat prote which is harmless but which stimulates the plant natural defences against viruses.

Example :- Virus resistance traits have been introduced into many crops including - Tomatoes, potatoes, tobacco, squashes, etc.

3- Resistance against Insects :-

plant can be made resistance against pest by introducing gene from Bacteria,

Similarly resistance can be improved in plants again microbial diseases. This not only increase quality of crops but also ecofriendly against environmental degradation. **Example :-** tomato, cotton.

(Q-9:) What are the achievement of genetic engineering in curing of animal diseases.?

Answer: Achievements in curing Animal Diseases:

The following achievements of Biotechnology help in curing of different animal diseases.

①- Human Insulin :- It is was the first genetic engineering product. In 1982, the human gene for Insulin was inserted into a bacterium. Since then, the modified bacteria are providing large amounts of human insulin.

②- Vaccine against Hepatitis-B :- Vaccine against hepatitis-B virus has been produced from yeast through genetic modification.

③- Human growth Hormone :- It was produced in genetically modified bacteria. It is used to treat dwarfism (short body)

④- Interferon :- It is antivirus protein, is made in genetically modified bacteria.

⑤- Vaccine against Foot and mouth diseases :- it is developed for foot and mouth diseases, a highly contagious viral disease that infect cattle, sheep, and other animals.

⑥- Vaccine against Coccidiosis :- coccidiosis a parasitic disease of the intestinal tract of animals. This vaccine kills protozoan that cause coccidiosis.

(7)- Treatment of Trypanosomiasis :- (Sleeping sickness)

It treatment may be possible through use of biotechnology techniques. Trypanosomiasis is a parasitic infection transmitted by a fly in humans and other animals. Genetic engineers are doing research to develop such proteins which kills the parasite of this disease.

(8)- Gene therapy :- It enable the treatment of genetic disorders. through this technique genetic engineers treat genetic disorders by introducing a gene into patients cells. It is being used to treat genetic disorders of blood.

(Q-10:) Define cloning. Discuss its various steps.

—OR—

How dolly was produced, outline the procedure?

Answer : Animal cloning :

Definition :- "The production of genetically identical cells or organisms is called cloning."

→ This is also called somatic cell nuclear transfer.

Types of cloning :-

There are three types of cloning. i.e—

1)- DNA cloning - in which DNA is produce.

2)- Embryo cloning - in which a mass of cells is produce.

3)- Reproductive cloning - in which whole body is produce.

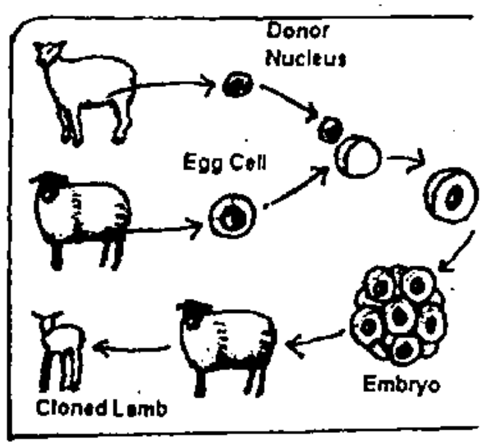
Dolly :- In 1997 Dolly-sheep was cloned successfaly by the process of reproductive cloning in Roslin institute in scotland.

procedure ;

Reprodutive cloning consist of the following steps.

①- Nucleus transfer :- In the first step udder cell from doner sheep was taken where as egg is taken from another female Dolly-sheep. The nucleus of egg was removed while the nucleus from udder cell is taken out and is incorporated in enucleated egg cell.

②- Stimulate cell division :- certain type of chemical treatment and electric shock is used to stimulate cell division (cleavage) in the egg cell. when cleavage is started it is now implanted in another female Dolly sheep.



③- Embryo transplant in host :-

The embryo is implanted

in the uterus of another female Dolly-sheep which act as surrogate mother (ulofirfle). where the further development of embryo take place in the uterus. After passing gestation peroid Dolly sheep (surrogate mother) give birth which is exactly similar to the sheep who's nucleus was used.

(Q-11:) what is single cell protein, write its uses ?

Answer: Single cell protein :

Definition :- "A protein produced by microorganism or algae is called single cell protein (scp)".

—OR—

"protein produced by a single cell is called SCP."

Explanation :- Microorganism change one substance to other where as some microorganism, yeast and Algae are good source of protein. e.g — yeast is used as food besides yeast blue green algae are also used like spirulina.

The term-single cell protein was coined in 1966.

Uses of Single Cell protein :-

Some of the major uses of single cell protein are as follow —

1— SCP are rich source of protein (60—70%), vitamins, crude fibres and minerals.

2— It used as popular health food.

3- It provide valuable protein rich supplement in human diet.

4- It reduce sugar level, so it is medically important for diabetic patients.

5- It possess gama linolenic acid which prevents the accumulation of cholesterol and reduces cardio-vascular diseases.

(Q-12:) What could be the draw backs of using single cell proteins ?

Answer: Draw backs of using single cell protein:

people hesitate to use single cell protein because of the following reasons-

1)- Indigestible :- Scp are slowly digestible therefore they some time cause vomating, and allergic reaction in stomach.

2)- Carcinogens : (Toxic)- some it contain carcinogens which cause cancer, etc.

3)- High nucleic-acid content:- SCP possess high level of nucleic-acid (4-6% in algae) and (6-10% in yeast). Therefore they cause Kidney stone problems and joints diseases.

4)- High cost :- Scp are expensive because of high cost production.

Exercise

(Q-A) Select the correct answer.

1- The enzymes which are used to cut the DNA in Specified Sequences is.

(a)- lagase (b)- protease (c)- DNAase ✓(d)- Endonuclease

2- The DNA molecule in which gene of interest for carrying to target cell is.

(a)- Transforming DNA (b)- carrier DNA (c)- phage DNA ✓(d)- vector DNA.

3- Endonuclease used in which genetic engineering are naturally used for-

(a)- Bacteriophage ✓(b)-Bacterial cell (c)- plasmid (d)-Bluegreen Algae.

4- Lactobacillus bulgaricus is a type of bacteria in the production of-

(a)- Alcohol (b) cheese ✓(c) yogurt (d) - All of the above.

5- Fermenter is a machine which is basically used for

(a)- Increasing fermentation (b) -production of enzymes used in fermentation.

(c)- production of microorganisms ✓(d)- making the conditions optimum.

6- In a technique for genetic engineering, rDNA Strand for-

(a)- Genetic makeup (b)- Replicative DNA

✓(c)- Recombiant DNA (d)- Retro-DNA.

7- Interferons are chemical which are used to.

(a)- Kill viruses (b)- Improve immunity

(c)- Work as vaccine (d)- All of the above.

8- which is a molecule containing DNA from two different organisms?

(a)- Vector DNA (b) DNA clone (c) plasmid DNA (d)- Recombinant DNA

9- what term is used for inserting to healthy gene into a person who has a defective gene?

(a)- cloning (b)- Gene therapy (c)- Vaccination (d) fermentation.

10- which of these can be used as a vector for inserting gene in bacteria.

(a)- plasmid (b)- Algae (c)- yeast (d)- E. coli

(Q-B:) write short answers to the following questions.

(1)- write about any four products developed through fermentation.

Answer: Fermentation products:

1- Alcoholic fermentation:- Alcoholic-fermentation is used to produced different products. such as— Bread, bear, wine and distilled Spirits.

2- Lactic-acid formentation:- Due to lactic acid fermentation milk sugar (lectase) convert into lactic-acid, which cause milk to curd and form yogurt.

Q- Name any four microorganisms used in biotechnology. Also name the process in which they are used.

Answer:- Microorganism used in biotechnology:-

1- lactobacillus :- used in lactic-acid fermentation to obtain yogurt from milk.

2- E.coli :- It is a Symblantic bacteria which used in Recombiant DNA technology as expression System (Host).

3- Bacillus thuringiensis :- gene (Bt-gene) obtain from such bacteria are used in transgenic plant, called Genetic modified plants, to develop pest resistance ability in such plants.

4- yeast and Algae :- It is used in Single cell protein production.

Q- Why are vectors used in genetic engineering?

Answer:- Vectors:-

Definition:- vectors are those agents which carrier genes of interest into host cell (e.g-Bacterial cell).

Explanation :- vectors are used to carry gene of interest from a test tube to host cell for cloning or Specific production. In vector a Specific Size gene of interest fit and than carry -vector have Self-replicating ability.

Example:- plasmid, act as vector present in bacterial cell.

(4) Q- write any five advantages of biotechnology in the field of agriculture.

Answer :- See Question No-8, at page No- 264

(5) Q- How is yogurt produced through the use of biotechnology?

Answer :- See Question No-2 (only see importance of lactic-acid fermentation), at page No- 257

(Q-C) write detailed answers to the following questions.

(1) Q- write a comprehensive note on the procedure of recombiant DNA-technology.

Answer :- See question No-7, at page No- 269.

(2) Q- How are single cell proteins produced and what is their significance.

Answer :- See question No-11, at page No- 269.

(3) Q- what is a fermenter and how does it work.

Answer :- See question No-4, at page No- 259

(4) Q- Describe the advantages of using fermenters for getting products from genetically modified organisms.

Answer :- See question No-5, at page No- 261.

(5) Q- Describe how biotechnology is helping mankind in the fields of food and health.

Answer :- See Question No-8, 9, at page No-265-264.

-End-